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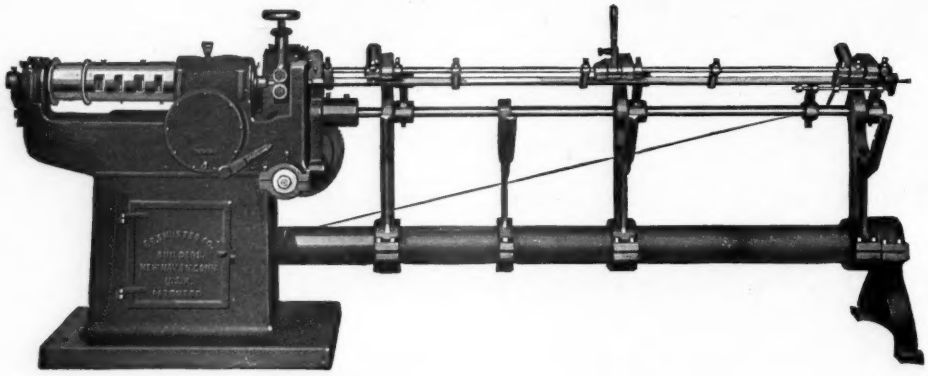

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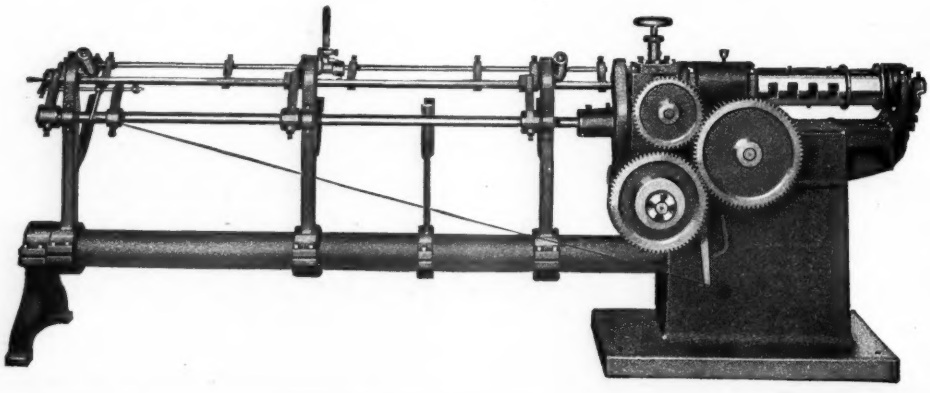

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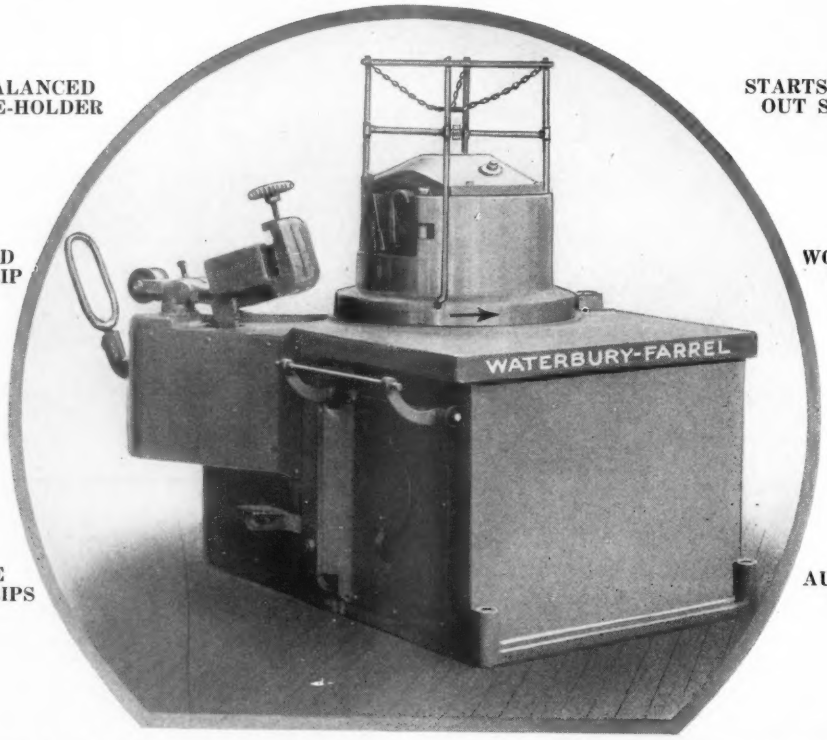

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WE are pleased to announce to our readers the proposed publication of a series of important articles in the manufacture of insulated cables. The introduction to these articles appears on page 277 of the present issue.

The insulated cable industry is increasing daily since the transmission of electric power in underground conduits is coming more and more into use. Every one knows that the manufacture of these cables presents greater difficulties as high tensions come into more general practice. In fact when the tension did not pass a thousand volts, no particularly delicate problems were raised in cable production. Today, however, 50,000, 80,000 and 100,000 volts are not uncommon so that the manufacture of cables requires a particular technique based on scientific laboratory studies.

The heating of cables, their insulation, their dielectric losses, etc., are important factors.

Mr. George Kessler, whose work in this field is authoritative, has written on the subject for the well known French magazine La Technique Moderne. Because we feel such articles would be of great interest to American manufacturers we have undertaken to translate Mr. Kessler's articles for publication in WIRE & WIRE PRODUCTS.

The articles will deal with the cable industry particularly in France. Mr. Kessler takes up the stranding of the cables, the process of insulation, and the laboratory and plant tests of the products.

THE PUBLISHERS.

* * * * *

One of the wire companies in the metropolitan district is making an intensive investigation towards improving diamond die technique. Articles on the subject are in preparation and will appear in an early issure of WIRE & WIRE PRODUCTS.

WIRE & WIRE PRODUCTS

A monthly publication devoted to wire drawing and wire forming

Vol. 2 August, 1927 No. 8

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Thomaston, Conn.

WIRE & WIRE PRODUCTS

Vol. 2 AUGUST, 1927 No. 8

Performance of New Installation in Stewart Hartshorn Plant

Analysis * shows great reduction in operating cost.

In collaboration with

J. M. Layng

Factory Manager, Stewart Hartshorn Co.

ALL No. 15 gage high-carbon steel wire used for the springs of Hartshorn shade rollers is now drawn at the East Newark (N. J.) plant of the Stewart Hartshorn Company on three two-unit batteries of Morgan-Connor Type A wire drawing machines.

It is considered very important that the several plants of this company have a dependable supply of the wire used for shade roller springs as well as for other purposes. The original trial of Morgan-Connor machines was made in an effort to accomplish this result. The first two units were installed in 1924 and four others have since been added. Results have been satisfactory in all respects.

The following report will indicate how it has been possible to reduce wire drawing labor costs by 35.5%, to save 58% in floor space and to so improve the quality of product that scrap is reduced to an unrecorded and negligible item.

Operating Principle

The Morgan-Connor machines are of the semi-continuous type, embodying the good features of both the ordinary single-draft and of the continuous drawing methods. Four blocks of the usual single-draft type make up a bench. Dome-shaped castings supported by the extension pins of each block permit the wire to be threaded through an axial opening, to sheaves below the block and then to the next die, the procedure being the same at each block.

Wire passes onto each block tangentially as it comes from the preceding die but since it is taken off parallel to the block axis it can be taken off faster or slower than it comes onto the block.

The blocks are geared direct to the main shaft. Relative speeds are not subject to change but the machine can be controlled as a unit by varying the speed of the motor. Block speeds are figured so that each block draws slightly more than the next block will take, the surplus being stored on the block pins. Tension on the wire is provided by means of a chain sliding in a groove in the dome and carrying a hollow link through which the wire is passed, the chain acting like a belt binder and maintaining a trim bundle of wire, with enough tension on the off-going strand to keep it on the sheaves.

STEWART HARTSHORN COMPANY

Table A

General Machine and Motor Test Data

Wire Machine

Morgan-Connor Semi-Continuous, Type A
Three 22-inch and one 20-inch block
Drawing: From No. 9 (0.1465″) to No. 15 (.0685″) in four drafts
Material: High-carbon steel used for shade roller springs

Motor Data

General Electric Form A, Type CD123, Serial 1439459
Shunt wound—30 h. p.—D. C.
230 volts—109 Amps.—400 to 800 r. p. m.

Test Results

(From run made on April 4, 1927)

	*Power Input (Kw.)	Wire Sizes Out of Blocks No. 1	No. 2	No. 3	No. 4
				(Machine running empty)	
	1.95	None			
	5.86	0 118″			
	11.71	0.118″	0.0965″		
	15.61	0.118″	0.0965″	0.0785″	
**	17.57	0.118″	0.0965″	0.0785″	0.0685″

* At 360 r. p. m., giving a finishing speed of 325 f. p. m. on the wire.
** Normal full-load operation.

Machine Layout

Each pair of Morgan-Connor machines is operated by one man. The two units face each other with just enough space

*Survey made by A. C. Nielson Company Engineers.

between to permit efficient work. There is little lost motion with this layout and a minimum of floor space is used. The 6 machines are arranged in two rows of 3 machines each, and occupy a 25x100-ft. area. This is less than one-half of that needed for single-draft machines.

Operating Methods

Spring wire comes to the plant in the form of No. 5 rod. It is classed as a high-carbon steel, the carbon content varying from 0.70 to 0.80% and the manganese content from 0.38 to 0.40%. Results obtained in drawing this high-carbon steel have been thoroughly satisfactory. The 20″ finishing block is often run at 100 r. p. m., this being considered an unusually high speed for this grade of steel.

The No. 5 rod is first put through a patenting furnace, after which it is cleaned, baked and drawn down to No. 9 gage in two drafts. It is then put through another patenting process, again cleaned, baked and given a lime coat before going to the Morgan-Connor machines in coils of 150 pounds each.

The reduction from No. 9 to No. 15 gauge is made in 4 drafts with the Morgan-Connor units. Standard 12-hole chilled iron dies are used for the first three blocks and steel dies for the finishing block. The wire goes onto block No. 1 at about 0.118″ diameter, onto No. 2 at about 0.0965″, onto No. 3 at about 0.0785″, and onto No. 4 at about 0.0685″. Wire is stripped from the 4th block with a hoist.

Wire leaving the machines is again processed, cleaned and baked, then goes to the finishing blocks and finally is rolled, hardened, and tempered for winding into springs.

The operators are unskilled men who were easily taught to run the Morgan-Connor machines without previous experience in wire drawing. The regular die makers take care of setting the dies and the operators have little reason for production delays. They regularly thread an empty machine in 6 to 8 minutes, but ordinarily lose even less time than this because it is entirely practical to start rethreading before the previous piece has entirely run off.

Operating Costs

An analysis of operating costs is given in tabular form on following pages. Table A shows general motor data and gives the results of input tests made on April 4 ,1927. The first two Morgan-Connor machines had 35-h. p. motor but motors of 30-hp. capacity have been found ample and are now in use on the four later units. The test data show an input of 17.57 kw. at 360 r. p. m. as the normal full load under regular operating conditions, this being equivalent to a finishing speed of 325 feet per minute.

The operating costs detailed in Table B include fixed charges, machine lubrication, die cost, die lubricant and power. Fixed charges are determined for the total investment in two machines on the basis of a 20-year life. Depreciation is $702.10 and average interest at 6% is $442.32 a year. The allowance for repair parts and labor are

(*Continued on page 281*)

STEWART HARTSHORN COMPANY
Table B
Operating Costs on Two Morgan-Connor Type A Wire Drawing Machines

Investment			
Two Type A machines		$9,260.00	
Two motors, complete with controls		3,716.00	
Freight charges		90.00	
Installation		975.00	
			$14,041.90
Fixed charges			
Annual:			
Depreciation—$14,041.90—20-yr. life		$ 702.10	
*Average interest @ 6%—21/20 x $14,041.90 x .06/2		442.32	
Maintenance and repairs—			
Annual allowances for parts and labor—			
Wire machines only		180.00	
Motors and electrical accessories		125.00	
Total		$1,449.42	
Daily:			
$1,449.42—260 nine-hour operating days			$ 5.58
Machine costs			
Lubrication—			
Oil—60 gal./yr. @ $.68	$40.80		
8 gal./yr. @ $.60	4.80	$ 45.60	
Labor—35 hr./yr. @ $.85	$29.75		
6 hr./yr. @ $.65	3.90	33.65	
Daily cost—260 divided into total of		79.25	.31
Dies—Total per day per pair of machines			3.00
Wire lubricant—(3 lb./wk. @ $.11) x (9/50 hr.)			.06
Power—(From tests, Table A)			
2 x 17.57 kw. x 9 hr. x 75% running time @ $.03/kw. hr.			7.12
Daily total (nine hr.) exclusive of operating labor			$ 16.07
Unit operating costs			
Machine cost per 100 lb. wire—$16.07—34 (C) lb.			$ .47
Labor rate, per 100 lb. wire			.21
Total			$ .68

*Allowing for interest earned by depreciation reserve.

STEWART HARTSHORN COMPANY
Table C
Savings Effected by Morgan-Connor Wire Drawing Machines

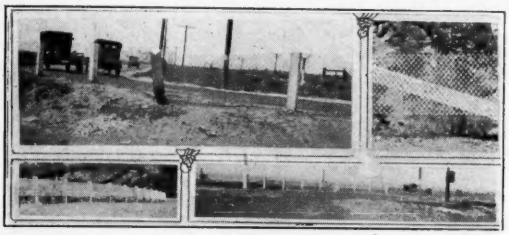
In labor			
Former cost per hundred pounds for equivalent reduction, including die-making:			
From No. 9 to No. 12	$0.21		
From No. 12 to No. 15	0.24		
Total		$0.45	
Present costs per hundred pounds:			
Attendance only (2 machines)	$0.21		
Die-making labor	0.08	0.29	
Net saving per hundred pounds		$0.16	
Cost reduction	$5.5%		
Daily saving—$0.16 x 34 (C) lb./9-hr. day		$5.44	
Annual saving, on two machines—$5.44 x 260 9-hr. days			$1,414.40
In floor space			
1167 sq. ft. per 2-machine battery @ $.25/sq. ft./yr.			291.75
(2500 sq. ft. vs. 6000 sq. ft., total)			
Total saving			
* Annual, on two machine			$1,706.15
Annual, on six machines—$1,706.15 x 3			$5,118.45
Unit, per 100 lb. of wire—$1,706.15—(260 x 34 (C))			$ .19
Return on investment			12.1%

*Net, since machine costs are approximately equal under present and former methods.

Road Fence Proves Effective

Guard fence in California stops car and saves motorist in accident.

FOR experimental purposes sixty-four feet of wire net guard fence was erected on the outside sharp curve at the Santa Fe Railroad grade crossing in California by the State Highway Commission.



Road fence on a California highway.

The twenty-four inch fence fabric is supported by six-inch posts, eight feet apart and set three feet into the ground. The two end posts were made from ten-inch piling set about five feet into the ground.

Shortly after the installation of the guard fence it was struck by a Ford sedan. One six-inch by six-inch post was broken off at the ground, and the wire fabric to adjacent posts (sixteen feet in all) was badly stretched but not broken. The sedan was only slightly damaged and was repaired and on its way in about an hour.

In the upper left photo is shown the wire fence with post broken, but wire net intact, upper right, detail section of the fence: lower right, view of the crossing before the accident.

Support for Reinforcing Wire Mesh

California Highway Engineers Perfect Device For Supporting Reinforcing Wire Mesh or Bar Reinforcing in Place in Concrete Pavements.

A DEVICE which appears superior to any method yet proposed for properly supporting reinforcing wire mesh or bar reinforcing steel in the construction of cement concrete pavements has been perfected by the engineers of the California Highway Commission. It consists of a bar into which are fitted adjustable hooks that hold the reinforcing mesh or bars in correct position during the placing of the concrete. The bar when in use rests across the header boards as shown in the photo.

Hook holds reinforcing mesh in position while mix is being laid.

To hold mesh or bar reinforcing in place so that it will have a proper position in the concrete slab has ever been a problem in the construction of pavements. Formerly reinforcing was held up by a small pile of concrete mix placed on the subgrade, but the reinforcing had to be adjusted from time to time as placing of the mix progressed. With constant watch-

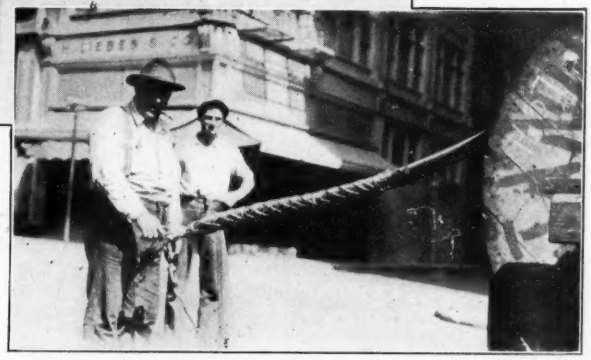
(*Continued on page 285*)

Novel Cable Clamp

Clamp made of wire affords efficient means of attaching rope to power cable in drawing through conduit.

THE accompanying photos show a very novel and efficient clamp designed by the foreman of the Great Western Power Company for use in attaching a wire rope to the end of one or several power and light cables for pulling same through a conduit under the street. The clamp is slipped over the end of the power cable and wrapped with wire at four places. The clamp is designed so that when the end is pulled by the wire rope the clamp grips the power cable so firmly that it cannot possibly slip off the cable, neither can the clamp injure the end of the power cable. It can be applied by one man in a few minutes, and can be used in pulling one or several power cables.

Extensible wire clamp for drawing cables through conduit.



Showing clamp gripping the end of a power cable.

The Relation of Steel Quality to the Drawing of Steel Wire

PART III

By E. A. Atkins, M. I. Mech. E.
Warrington, England

The Making of Clean Steel Suitable for Wire-Drawing

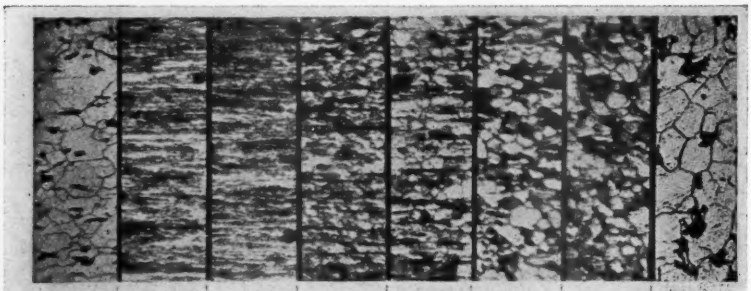
As the quality of steel wire and several other products is very seriously affected by small non-metallic inclusions, it is worthy of prolonged investigation to discover the methods by which steels of suitable quality can be produced economically. The problem really resolves itself into one of how best to deoxidise the steel.

The removal of non-metallic inclusions in mild steel is not so difficult as in the case of medium and high-carbon steels, as the mild steel apparently lends itself better to a final prolonged treatment in the furnace with manganese, which gives time for the inclusions to float to the surface. If deoxidation has been carried sufficiently far and there are no further additions of ferro-silicon or aluminium either in the ladle or ingot moulds, there would appear to be nothing, apart from refractory inclusions, which could cause the formation of specks of a non-metallic character.

In the case of high-carbon steels if the deoxidation in the furnace has not been carried sufficiently far, the additions of ferro-manganese and ferro-silicon in the ladle will result in the formation of silicates which will not have sufficient time to pass up out of the steel before it is run into the moulds.

Dr. McCance[1] mentions that a possible additional cause of the formation of deleterious inclusions may be the passing back of silicon from the slag into the steel, leaving myriads of silica specks which are ultimately converted into manganese silicate, or a complex silicate of manganese and iron. Possibly this may be the true explanation for the appearance of some kinds of specks.

Again, as the temperature of the steel, both in the bath and ladle, has a considerable controlling influence in the amount of deoxidation which takes place, this in itself may be one of the determining factors in the production of clean or dirty steel.



Rod	Wire 16g.						
Carbons 0·12 %							
Time of heating		15 mins.	25 mins.	60 mins.	120 mins.	120 mins.	150 mins.
Highest temp.		540°C.	600°C.	735°C.	840°C.	900°C.	1010°C.
Time held at highest temp.		15 mins.	25 mins.	10 mins.	10 mins.	10 mins.	10 mins.
Time of cooling		50 mins.	50 mins.	60 mins.	60 mins.	100 mins.	130 mins.
Tensile strength	64·3 tons	34 tons	24·25 tons	25·46 tons	25·2 tons	25·25 tons	25·05 tons
Elongation per cent. in 2 inches	2·5	12·5	20	25	22·5	22·5	22·5
Twists in 8 inches	46	80	103	117	126	142	88

FIG. 37.—Variation in structure and physical properties of 16 gauge mild steel wire under different heat treatments. ×100. (Reduced to ⅔.)

Dissolved Oxide in Steel

Perhaps one of the most complex problems in steelmaking is that of the effect of oxide of iron when in solution in steel. This latter factor is probably one of the disturbing influences in connection with the torsioning of steel wire. The torsion test, which is commonly applied to hard steel wire, consists in twisting to destruction a definite length of the wire, say, equal to 100 diameters. Supposedly good wire will give from thirty to forty or more twists before it fractures, and the fracture usually takes the form of a shear at right angles to the axis, but in wire of indifferent quality it assumes a ragged form.

It is difficult to know what the torsion test actually measures in wire, except perhaps that it is an indication of the density of the steel, its freedom from surface defects, and its general good quality. The torsion test results may, however, be affected in several ways. In the patenting or tempering of wire, if a high temperature is used causing large grain-size, the torsional properties of the wire are usually improved, whilst the other physical properties may be impaired. Again, when wire is drawn from harsh or oxidized steel, the torsional properties are very considerably reduced, and from this it would seem reasonable to conclude that the percentage amount of oxide in solution in the steel is one of the potent factors which affect the twisting of a wire. On the other hand, wire drawn from oxidised steel has considerable torsional

1. Trans. of Faraday Soc. Dec. 1925, Vol. XXI, pt. 2, p. 149.

stiffness or rigidity, which is a useful property in wire for making the cheaper kind of cylindrical or conical springs which, in practice, twist only a few degrees. It may be that there is some use for a steel or an iron which is definitely alloyed with its own oxide, and the last-mentioned case appears to be an illustration of this.

Whilst an enormous amount of work has been carried out by Dr. McCance and others on oxide in steel, nothing seems to have been done to show that steels containing a definite oxide content can be put to commercial uses.

In cleaning or pickling wire by hydrochloric or sulphuric acid there can be no doubt that oxide in solution, free oxide, and small silicate specks are considerably affected by occluded hydrogen, probably causing the formation of water vapour or other compounds which set up internal pressure in the steel, resulting in actual bursting of the wire or in other ways deteriorating its quality. Experiments on various kinds of steel certainly show that some are affected much more than others, giving out a larger volume of hydrogen or water vapour when subjected to coating processes, or merely when allowed to stand over a lengthy period.

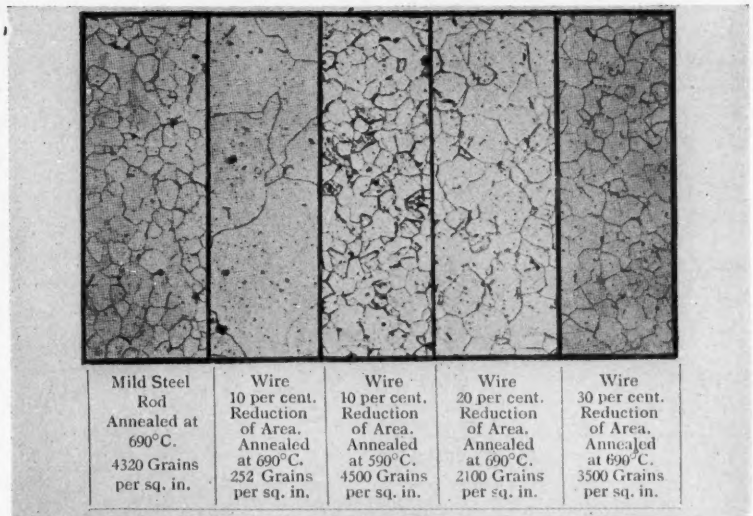

Mild Steel Rod Annealed at 690°C. 4320 Grains per sq. in.
Wire 10 per cent. Reduction of Area. Annealed at 690°C. 252 Grains per sq. in.
Wire 10 per cent. Reduction of Area. Annealed at 590°C. 4500 Grains per sq. in.
Wire 20 per cent. Reduction of Area. Annealed at 690°C. 2100 Grains per sq. in.
Wire 30 per cent. Reduction of Area. Annealed at 690°C. 3500 Grains per sq. in.

FIG. 38. Variation in grain size due to varying cold-work strain and heat-treatment. ×100. (Reduced to $\frac{2}{3}$.)

Surface Blisters After Coating

A good deal of discussion has taken place recently on the cause of blisters on coated surfaces. These blisters, as has often been proved, actually develop in the pickling cistern, and, in the opinion of the author, are due to the minute inclusions above mentioned which are near the surface, and which, when disintegrated, leave behind products that lift up the tin or other metal during or after coating. In galvanising, tinning, or electro-plating, the occluded hydrogen may have a seriously disturbing effect upon the deposited metal.

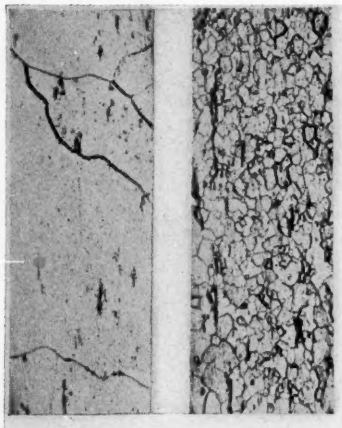


FIG. 39. Longitudinal section of two pieces of the same wire, with large and small grains respectively ×100. (Reduced to $\frac{5}{11}$.)

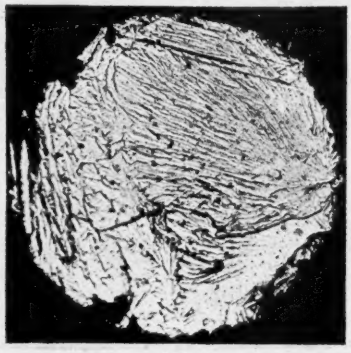


FIG. 40. End of fine wire, showing conchoidal fracture. ×50. (Reduced to $\frac{5}{11}$.)

Effect of Accidental Constituents in Steel

Whilst small quantities of nickel for some purposes have very little effect upon the quality of wire, it has been found that when the nickel reaches 0.20 per cent. and over, difficulties arise in the cleaning of the rods. The effect of so small a quantity of nickel is shown by the scale turning red when the rods are hot-rolled. Unfortunately, this red oxide is converted in the pickling bath into a complex iron-nickel oxide, which is not removed from the wire by subsequent pickling. This retards the formation of the necessary ferric hydrate coat on the rod or wire which is intentionally formed after cleaning to facilitate drawing. It might be contended that this black deposit could be readily removed by the use of nitric acid, but it must again be pointed out how impossible it is to adopt abnormal processes to meet particular circumstances.

In the making of steel, therefore, for ordinary wire-drawing purposes, care should be taken to keep the nickel content as low as possible, say down to 0.10 per cent. It might also be mentioned that the presence of nickel has a disturbing influence in connection with annealing.

Trouble has been caused occasionally through the presence

of abnormal amounts of copper and tin in wire-making steel. This tends to make the edges of billets crack in the hot-rolling, resulting in roaks (Fig. 36) on the surface of the rod, which give rise to what is known as "herring-boning" on the wire.

Unfounded Complaints of Bad Quality Steel

Whilst the steel-maker has all kinds of complaints to deal with in reference to the quality of his steel, there are many cases where complaints are unfounded. In former days material was classified as "good," "bad," or "rotten," and whilst perhaps the latter two qualities were reported to the steelworks, the former one was rarely mentioned. But investigation has shown that in some cases high-class material has been spoilt through wrong treatment in passing through the various processes, the quality of steel being blamed if the results were not as anticipated.

That a piece of 16-gauge mild steel wire can have very varying physical properties under different conditions of heat treatment is shown by Fig. 37. It will be noticed that an untreated 16-gauge mild steel wire has a tensile strength of 64.3 tons per sq. in. and an elongation of 2.5 per cent., the wire giving 46 twists in an 8-in. length before breaking. After the heat treatments as indicated, the tensile strength varies between 34 and 35 tons per sq. in., the elongation between 12.5 and 22.5 per cent., and the twists between 80 and 142. With such varying results between the limits of heat treatment shown it can readily be seen that an almost infinite variety of physical properties can be induced, even in a bit of mild steel wire, under different conditions of annealing. It is thus manifest that where heat treatment is used to bring about certain results there is need of great caution before blaming the steelmaker for the bad quality of the steel.

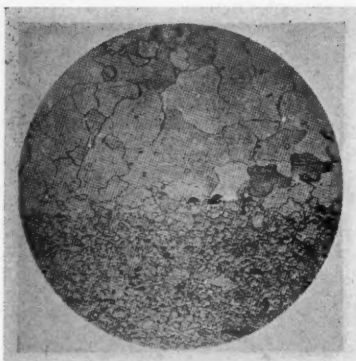


FIG. 41.—Large grain growth at surface of wire. ×50. (Reduced to $\frac{6}{11}$.)

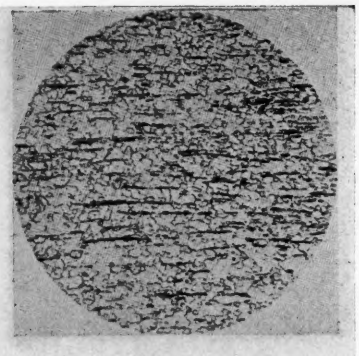


FIG. 42.—Low-temperature annealed mild steel wire showing fibres of pearlite. ×100. (Reduced to $\frac{6}{11}$.)

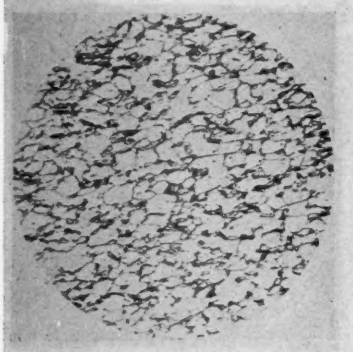


FIG. 43.—High-temperature annealed mild steel wire, showing the elimination of pearlite fibres. ×100. (Reduced to $\frac{6}{11}$.)

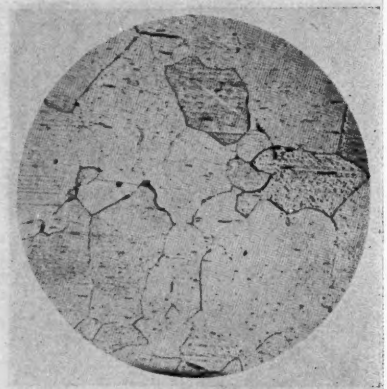


FIG. 44.—Large grains in mild steel wire with cementite at the boundaries. ×100. (Reduced to $\frac{1}{2}$.)

Perhaps one of the most peculiar results obtained in connection with the annealing of mild steel is the extraordinary difference in the grain growth according as the area is reduced in wire-drawing. Five illustrations of this are given in Fig. 38. For the purpose of this test many wires were drawn out of identical material, and were heated in the annealing furnace in the same position and at the same time so as to ensure uniform conditions. Where three wires with respective reductions of area of 10, 20, and 30 per cent. had been annealed at 690°C. the number of grains to the square inch were, respectively, 252, 2100, and 3500. At the lower temperature, 590°C., the wire, having a 10 per cent. reduction of area, gave 4500 grains to the square inch. Steels giving such varied results have often been denounced as worthless, whereas the problem is purely one of correct heat treatment.

Similarly, in fine wires where the annealing had not been car-

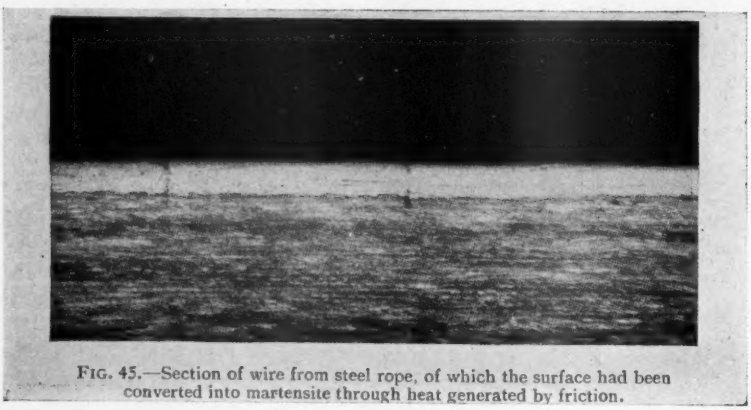


FIG. 45.—Section of wire from steel rope, of which the surface had been converted into martensite through heat generated by friction.

Table I.

	Tensile Strength Tons per sq. in.	Elongation on 2 in. Per Cent.	Twists 100 Diameters	Bends. 5-mm. Rod	No. of Snarls
10 gauge. Annealed at 720° C. and drawn to 11 gauge	30.8	10	16	8	2
10 gauge. Annealed at 820° C. and drawn to 11 gauge	30.4	10	93	13	9

ried out under conditions suitable to a low-carbon material, the grain was caused to grow sufficiently large to cover the full diameter of the wire (Fig. 39, left), causing intense brittleness, as shown by the conchoidal fracture of an enlarged end view of the broken wire (Fig. 40). Yet only a few inches farther along on the same wire the material was found to be tough and showed small grain, as seen on the right of Fig. 39.

A much more difficult case to deal with in connection with annealing is where wire has a very low carbon content near the surface and a higher content in the middle portion. This unfortunately often results in large grain growth at the surface (Fig. 41) which, if it does not cause fracture, will produce a lumpy appearance on the surface of the wire when bent. There are also cases where the steel of wire or strip has been described as bad, but has simply been made defective by being carburised by contact with carbon monoxide, either through cracked annealing pots or through overheating in the presence of fresh cast-iron borings.

Effect of Varying Carbon Contents and Temperature on Annealing for Subsequent Cold-Work.

Bad quality of steel is sometimes blamed for the numerous breakages in connection with mild steel which has to be drawn down to fine gauges of wire, but this more often than not is due to low-temperature annealing. When mild steel wire has been annealed for subsequent drawing into fine gauges its temperature certainly ought to be above Ac_3 point, but this is very rarely obtained under ordinary conditions of practice.

The disadvantages of using temperatures 750° C. in pot annealing are the sinking of the pile of hot bundles which causes the wire to stick together, thus presenting difficulties in separation for cleaning, and the lowering of the strength and life of the annealing pots. In open furnace work the wire scales too heavily to allow of quick cleaning, quite apart from the loss in weight.

In pot annealing, unless the greatest care is exercised, the temperature rarely exceeds 750° C., and whilst this is quite sufficient for purposes of finished annealed wire, it has a very

(*Continued on page 285*)

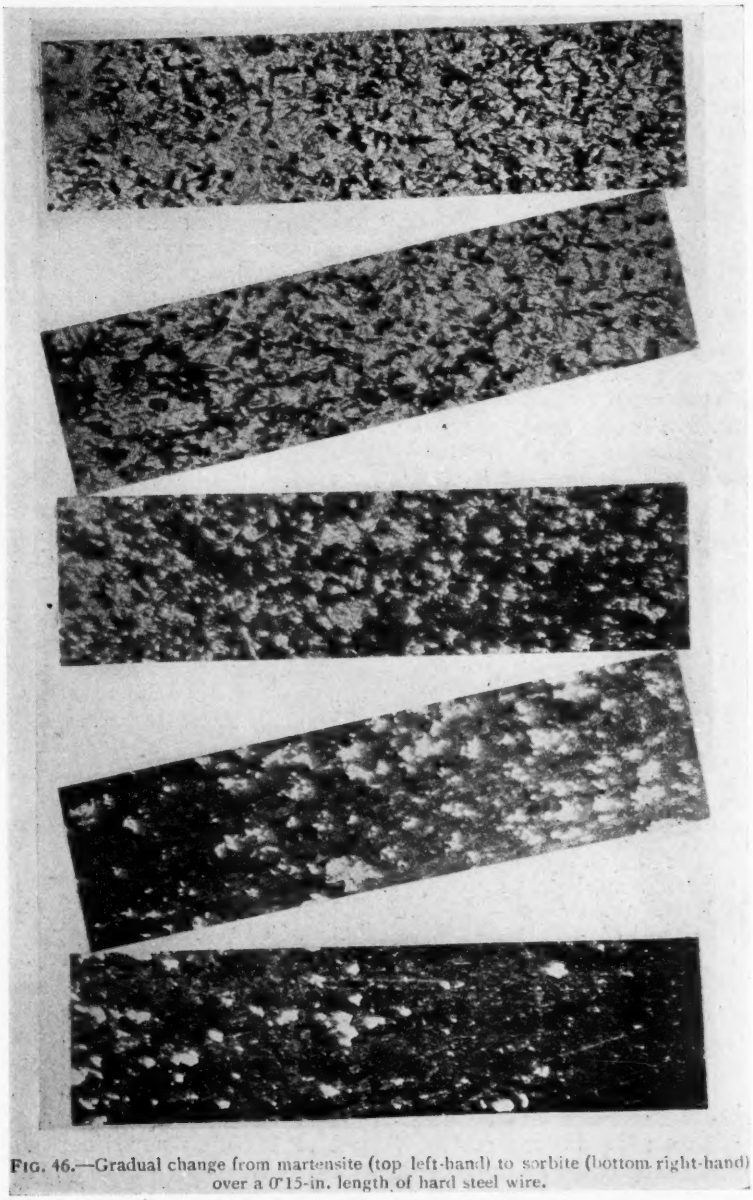


FIG. 46.—Gradual change from martensite (top left-hand) to sorbite (bottom right-hand) over a 0·15-in. length of hard steel wire.

No Confusion Between Waterbury and Roebling Wire Rope Trade Mark

Court holds mere color does not constitute trade mark for any article

Waterbury Company, Opposer, v. John A. Roebling's Sons Co., Opposition, No. 6455; Commissioner of Patents.

THE applicant's green-cored cable was held not likely to be confused with opposer's ropes using green strand, since more than ordinary care is used in establishing identity of ropes, in view of practice of marking ropes by colored strands.

Lamb and Co. for opposer. Philipp, Sawyer, Rise and Kennedy for applicant.

The full text of the opinion of Second Assistant Commissioner of Patents Moore follows:

This in an appeal by the opposer, the Waterbury Company, from the decision of the examiner of interferences dismissing its notice of opposition to the registration by the applicant, John A. Roebling's Sons Co., of its trade mark for wire rope.

Trade Mark Consists of Green Fibrous Core

The applicant's trade mark "consists of a green fibrous core of the wire rope, for wire rope."

The Waterbury Company opposes the registration of the applicant's mark on the ground of its alleged prior adoption and use of a trade mark for wire rope of which one of the strands is colored green; also, that long prior to the date of adoption of applicant's mark, to wit, in May, 1913, the opposer adopted and began to use as a trade mark for manila rope and manila drilling cable a green colored strand, thread or marker, placed at or near the center of one of the strands of said rope or cable; that long prior to the alleged date of adoption of the applicant's mark the opposer adopted and began to use as a trade mark for wire rope, the representation of a section of wire rope, one of the strands of which is colored green, with the words "Green Strand Giant Steel Wire Rope," printed upon it, and that the said mark was duly registered June 10, 1924, as No. 185331.

The opposer contends that the applicant's mark consisting of a green core, in a wire rope, is essentially a centrally placed green strand, and is so similar to the opposer's marks as to cause confusion in the mind of the public when the respective marks are concurrently used on goods of the same descriptive properties, and that the registration of the applicant's mark would cause irreparable injury to the opposer.

Continuous Use Claimed Since 1924

The applicant in its application for registration claims continuous use of its trade mark since about the 5th day of February, 1924.

The primary question raised by this appeal for decision is whether the applicant's trade mark so nearly resembles those of the opposer as to be likely to cause confusion or mistake in the mind of the public or to deceive purchasers.

In order that the opposition to the registration of the applicant's trade mark may prevail, the opposer must show that confusion in trade and consequent damage to the opposer would be likely to result from such registration. This brings into question the opposer's trade mark rights with respect to the subject matter in controversy.

The adjudicated cases referred to in this proceeding, and many others, show that it is common practice among manufacturers of wire ropes and cables to provide the ropes and cables with color devices, whereby the products of each manufacturer may be distinguished from the like products of the competing manufacturers.

Colored Thread Long Used to Mark Rope

Judge Lowell remarked, in delivering his opinion, that: "A colored thread of some sort twisted in the rope is, evidently, almost or quite the only possible way of marking or identifying the rope itself, and it is evidence that a colored thread has been commonly used for many years for such a purpose, though seldom, if ever, has it been used as a mark of origin."

It has also been established by a long line of adjudicated cases that there can be no trade mark right in mere color (see A. Leschen & Sons Rope Co. v. Macomber & Whyte Rope Co., 142 F. R. 289, and the decisions therein referred to).

This proposition is based upon the fundamental idea that a trade mark is a distinct word, emblem, symbol, or device, or a combination of these, used to indicate or identify the manufacturer or seller of the goods to which it is appropriated.

Colors belong to the public domain, and every manufacturer or trader has the right to paint his wares whatever color his judgment or fancy may dictate. Color, therefore, may not constitute a valid trade mark, as it does not possess those properties or characteristics by virtue of which the goods of one manufacturer or trader may be distinguished from like goods belonging to another.

Must Be Employed In Particular Design

It is only when color is "impressed in a particular design, as a circle, square, triangle, a cross, or a star," that it may constitute a valid trade mark (Leschen Rope Co. v. Broderick, 201 U. S. 166).

In the latter case Mr. Justice Brown remarked:

"It is true that the drawing annexed to the registration, a copy of which is here given, as well as the exhibits furnished, shows one of the strands colored red; and if the trade mark were restricted to a strand thus colored, perhaps it might be sustained; but the description of a colored streak, which would be answered by a streak of any color painted spirally with the strand, longitudinally across the strands, or by a circular streak around the rope, was held by both courts, and we think properly, too indefinite to be the subject of a valid trade mark.

"Certainly a trade mark could not be claimed of a rope, the entire surface of which was colored; and if color be made the essential feature, it should be so defined, or connected with some symbol or design that other manufacturers may know what they may safely do.

"Upon the plaintiff's theory, a wire rope containing a streak of any description or of any color would be an infringement, and a manufacturer honestly desiring to distinguish his wire rope from that of the plaintiff's by difference in color might, by adopting a white streak running along the length of the rope across the strands, find himself an infringer, when his real object may have been to retain a mark which would distinguish his manufacture from that of the plaintiff's.

"Even if it were conceded that a person might claim a wire rope colored red or white, or any other color, it would clearly be too broad to embrace all colors. So, although it might be possible to claim the imprint of a colored figure on a wire rope, the figures should be so described that other manufacturers would know how to avoid it.

"If the trade mark be a colored streak, it should be, at least, described and a statement of the mode in which the same is applied and affixed to the rope; and a trade mark which may be infringed by a streak of any color, however applied, is manifestly too broad."

Right Rests on Manner In Which Color Used

As mere color may not constitute a valid trade mark, the opposer's trade mark rights with respect to the green color must rest upon the particular manner in which the color is impressed upon its wire rope. It is not entitled to trade mark rights of such breadth as to include all possible ways in which this color may be impressed upon articles of trade, as above indicated, or even to all ways in which it may be impressed in or upon wire rope.

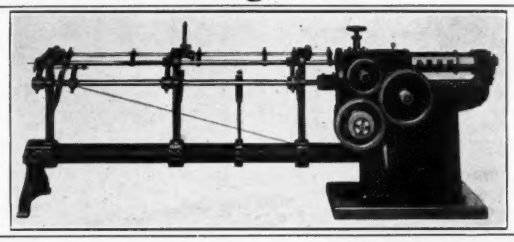
Now, the opposer's green strand trade mark is not the same as the applicant's green core trade mark; and it is not seen that confusion in trade would be more likely to occur as between the applicant's and the opposer's mark than would be likely to occur between their marks and the antecedent color devices employed by other manufacturers to distinguish and identify their respective wire rope products.

As a matter of fact, by reason of the many color devices that are being employed by manufacturers of wire ropes and cables to distinguish and identify their respective products, purchasers are called upon to exercise more than ordinary care in establishing the identity of the ropes and cables which they seek to purchase, and when such care is exercised it is believed that one seeking to purchase the Waterbury Company's green strand rope would not be deceived into purchasing the green core rope manufactured by the John A. Roebling's Sons Co.

The decision of the examiner of interferences dismissing the opposition is affirmed.

(From United States Daily)

New Wire Straightener



The new Shuster Straightener of novel design, requires but one belt.

ONLY one belt is required to drive this machine; it runs to the arbor, which acts as a main driving shaft for the entire machine. The feed rolls and cutting off mechanism are driven from the arbor by means of a hardened tool steel worm, and bronze worm gear, run in oil.

The Arbor is made of steel, and is mounted in Timken Roller Bearings.

The base of the machine may be extended so that a motor can be mounted thereon, and belted through slots in the bed to the Arbor making it a self contained machine. Or, the motor may be placed on the floor, or ceiling, and belted to the arbor.

It is thoroughly equipped with guards, but they are not shown in the illustration, in order to show the working parts better.

It is made in three sizes.

The wire is fed out through the straightening arbor, into a covered guide bar in which is located an adjustable gauge that may be set to cut any length within the capacity of the machine. This gauge is connected with a clutch on the camshaft and when the wire strikes it, the clutch is thrown in, and the cutting mechanism works instantly. At the same time the cover of the guide bar opens and the cut length drops out into the forked holders provided for the purpose.

The Galvanization of Iron and Steel Wire

PART. II *

Various zincing processes.—A study of iron zinc alloy zones

By H. Altpeter

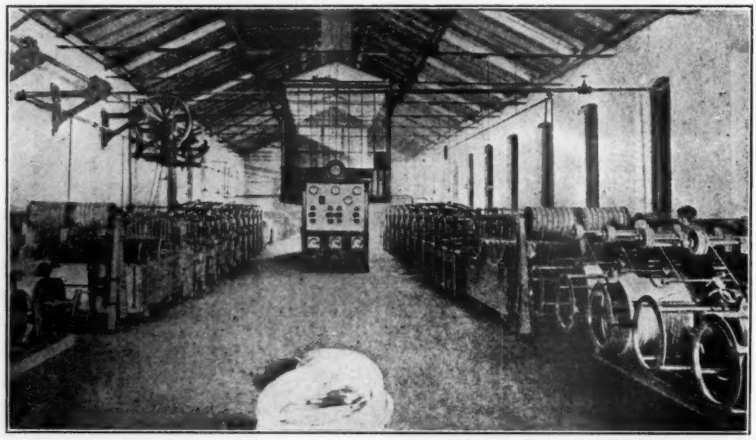


Fig. 7—Installation of a galvanic zincing equipment by Malmedie & Co., Düsseldorf.

THERE are three hot-zincing processes: dipping in hot liquid zinc as described in connection with wire, annealing in zinc-dust, a process patented by Sherard-Cowper-Coles & Co., and the so-called spray process after Schoop. Wire-nettings, however, can only be zinced in the hot zinc bath. The process is identically the same as the one described under wire-zincing. The tubs usually measure 2m in width and two nettings usually are dipped along side of one another. One commonly employs the sand-zincing process after pickling the wire in diluted sulfuric acid. The velocity of the dipped wire depends upon its thickness and the width of the meshes. The thinner the wire and the wider the meshes the greater the velocity.

Nails are first degreased in a sawdust filled drum, then placed upon a perforated foundry-ladle, where they are shaken in a solution of chloride of zinc, and dipped into the zincing bath. The dipping has to be done very slowly in order to prevent the chloride of zinc or the oil remains from developing too suddenly into gas, as such suddenly generated gas blows the nails out of the bath. The nails remain in the bath until they acquire the temperature of the hot zinc. This status is reached if they no longer stick to one another but can easily be stirred by means of a bar. The lifted ladle is vigorously shaken in order to remove the superfluous zinc. One sometimes powders the nails with ammonium chloride so as to assure an even flow-off of the surplus zinc. This process, however, develops gas which has an ill effect upon the health of the workers. The nails are then covered with wet sand and shaken and finally spread out until they are cooled off. Very small nails are shaken through a sieve to prevent their forming lumps. The coatings so produced are rough, but very thick and offer an excellent protection against rust.

*For Part I see Wire, July, 1927 page 233.

The Sherard-Cowper-Coles Process for the Zincing of Small Objects

The items are rolled in zinc-dust and placed into a hermetically closed container. The latter is exposed to dark-red heat. Screws and nails are zinced in a rotating, externally heated drum. An exposure of half an hour suffices to produce a thin coating. This coating can be made thicker under extended heating. The coatings thus produced are said to distinguish themselves through uniformity of thickness and density. The zinc which is used for this purpose is a byproduct of the zinc-distillation-process. It is metallic but non-refusible and is deposited on the lower walls of the hearth and the drainage channels of the distilling furnace. This zinc-dust contains from 8 to 10% oxide of zinc. Especially the presence of oxide of zinc seems to be essential for the proper performance of the Sherard-Process. It also contains a certain percentage of coal-dust and hydrocarbons, such as fats and oils. The latter byproducts act as a check on oxidation. The process is well suited for nails and screws as it is said to eliminate the cleaning of the screw threads. It is also employed for the zincing of steel-ware because it requires but low temperatures from 250 degrees C to 400 degrees C. The zinced ware remains in the drum until it is completely cooled off so as to avoid oxidation. The used zinc-dust gradually loses its pure zinc and has to be removed and replaced as soon as the zinc contents drops below 20 per cent. The formation of an alloy be-

tween zinc and iron assures firm adhesion of the coating.

The Spray Process After Schoop

Although Schoop's process is a comparatively recent development, it has already shown exceptional success. It is a property of liquid metal particles to form a compact coating if blown under high pressure upon a chemically pure surface. This commonly known observation forms the basis of the Schoop-Process. Schoop also tried to blow dry zinc-dust upon metallic surfaces, but arrived finally at a comparatively simple apparatus. Although it is based upon the frequently applied practice of blowing liquid metals, it embodies a new idea. Schoop burns in a blow-pipe compressed hydrogen and oxygen (or air) and introduces in the center of the pipe a wire of the metal that is designed to serve as coating. This wire runs through a small turbine and is automatically adjusted. That is to say, the wire passes at the rate into the pipe as it is melted in the pipe. Easily oxidizable metals can be blown with reduced or neutral gas, such as nitrogen. The process permits the coating of various substances. The future will show whether or not it is suited for zincing small items, such as nails, bolts, and screws. The coatings are compact and durable and can be produced as thick as one desires. A thorough sand-blast or sawdust cleaning is all that is needed to prepare the items for effective application of this method.

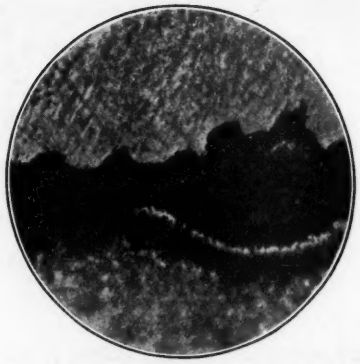


Fig. 8 Photomicrograph of a section of hot zinced wire treated according to Winter's method to show iron zinc alloy formation.

Galvanic Zincing

Galvanic zincing takes a prominent place alongside of hot-zincing. This process became popular because it can be performed under normal temperature, does not develop poison gas, and produces coatings of unobjectionable quality. This process is based upon the solubility of zinc under the influence of current. The dilution takes place in a bath through which the wire runs. The zinc plates serve as anodes and the passing wire as cathode. This arrangement permits regulations of the diluted zinc. The electro chemical equivalent is 0.339. A current of 1 amp. disengages in one hour 1.22 g of zinc from a cathode having an area of 1 sq. m. The relation between current density and electro-zinc does not fluctuate. Galvanic zincing—like all other galvanic processes—requires currents of low voltage (2.5 to 4v), but high density (100 amp. and above). Current density and voltage given, it is not too difficult to estimate the capacity of a galvanization plant. These two factors furthermore permit calculations as to the volume of wire that can be galvanized per hour. The process takes place in water solutions of zinc-salt which vary as to their intensity. The so called "basic baths" are not advantageous, as the disengagement of basic zinc-oxide results in spongy deposits. The detailed composition of the bath usually is kept secret, and only communicated upon purchase of an electro-galvanic plant. The Langbein-Pfanhauser Werke A. G., Leipzig-Sell, Germany, are one of the best known German manufacturers of such plants. They build wire-zincing plants of various capacities and for all kinds of wire. The various bath-compositions require various current densities, thus influencing the production cost of the zinced wire. Dr. Georg Langbein presents in his book two formulae for zincing bath compositions with a brief description of the required current density, voltage, and temperature. These two baths suffice in most cases to produce satisfactory coatings. The method of Dr. Pawek is also often used, it, too, permits the application of current of high density.

A long hall (see figure 7 or 9) is best suited for installation of an electro-galvanic plant. Such a plant usually contains a dynamo-machine, a switchboard, vessels for pickling, several galvanization tubs, watering and drying facilities, and the spool-

(*Continued on page 282*)

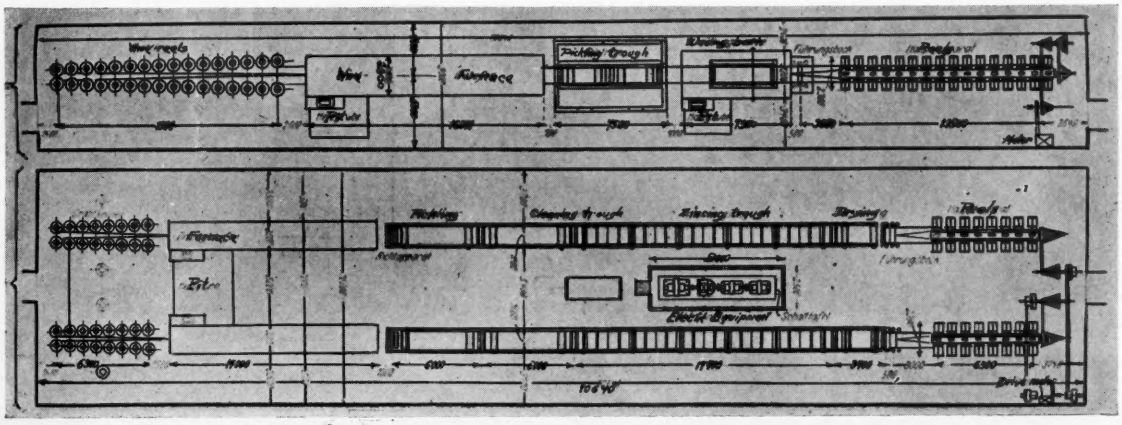


Fig. 9 Zincing equipment for 32 wire in a German Plant.

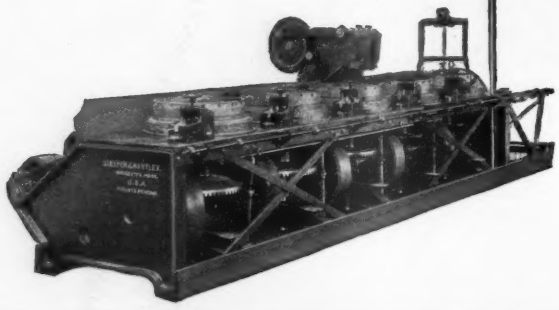
Sleeper & Hartley
TRADE MARK

Practical Continuous W

These Machines Go Into Production at

Rod Frame

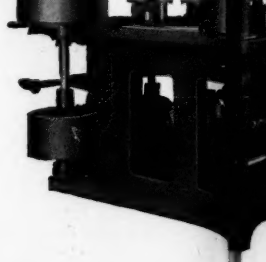
(No. 5—14 or 15 wire)
Patented June 3, 1924—May 12, 1925—others pending
All Ball or Roller Bearings
No Differential Gearing.
Automatic Compensation for Speeds of Heads.



Double 5-Draft

No. 14 to No. 23.
3 to 4 Blocks
No. 14 to 19—4
No. 14 to 20—5

More than 250 heads of th



WIRE MILL EQUIPMENT

TINNING AND GALVANIZING FRAMES AND WIPERS

PATENTING FURNACE TAKE-UPS

WIRE POINTERS. WIRE PULLERS

WIRE SPOOLING DEVICES

MULTI-HEAD WIRE STRAIGHTENING AND CUTTING MACHINES

WIRE TWISTING AND STRANDING MACHINES

AGENTS: CHICAGO TERRITORY,
Neff, Kohlbusch & Bissell, Inc.

SLEEPER &

FOREIGN AGENTS AND REPRESENTATIVES: UNITED KINGDOM—Mr. Fredk. A. Perry. 63 Queen Victoria St., London. E. C. 4. FRANCE—Mr. Edgar Bloxham, 12 Rue du Delta. Paris. BELGIUM—Isbecque, Todd & Cie., 25-27 Boul. Emile Bockstael, Brussels.

WORCESTE

Wire Drawing Machinery

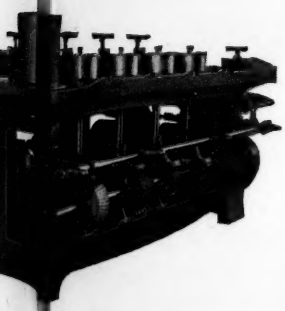
Sleeper & Hartley TRADE MARK

REG. U.S. PAT. OFF. & PRINCIPAL FOREIGN COUNTRIES

n at ...—Reducing Overhead-Increasing Production!!

...raftry, Intermediate

...23. ... or low carbon wire.
...ocks ...erage Operator.
...—4 ...400 lbs. per block.
...—5 ...100 lbs. per block.
...of th...roved model in operation

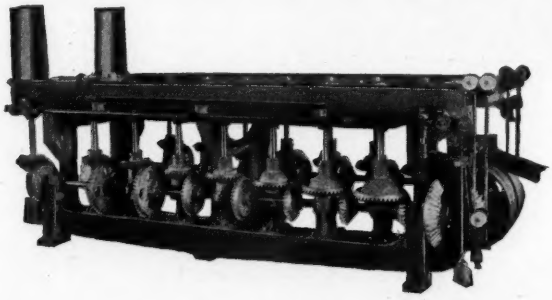


Double 8-Draft Fine Wire: Wet

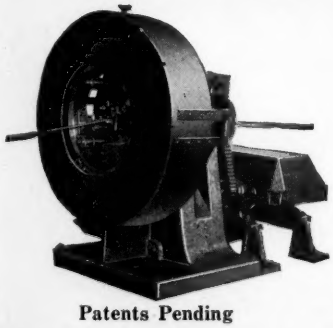
No. 22 to 36. High or low carbon wire.

6 Blocks to Average Operator, 22-33, 8-hole, 660 lbs. per day of ten hours.

Many thousands of these heads in operation



ARMORING MACHINES FOR "BX," PARK CABLE MOTOR WIRES, HOSE Etc., Etc.



Patents Pending

High Productive Speeds

LOCK WASHER MACHINERY

with Enormous Output

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EDITORIAL · IMPRESSIONS

High Price of Variety

NOT seldom fabricators of wire products complain of a slump in trade which often interrupts the continuous operation of their plant. Production has to be curtailed because consumption has decreased.

The consequent reduction of employment and the necessity of operating the factory below full capacity introduces severe complications and material losses. Are these avoidable or are they inevitably rooted in our social and industrial system?

The continuity and regularity of employment is a vital problem of all manufacturers and is intimately connected with continuity in consumption. Because the question often comes before wire products fabricators (perhaps chiefly on account of the large variety of their products) it deserves very careful analysis.

"Does steady employment sustain consumption, or does steady consumption sustain employment?" asks Mr. R. M. Hudson of the Department of Commerce. "The answer seems to be that without the one we cannot have the other."

"It is commonly understood that times are good when there are plenty of jobs for all who want to work, for when wages are usually good, and labor has money to spend for goods and commodities over and above the necessities of life. At such times, merchants are doing good business, and placing orders regularly with the manufacturers, thus assuring the employees of the latter steady work at good wages."

"Census figures show we now have over 42,000,000 workers gainfully employed. Obviously we have the problem of maintaining conditions that will permit their full employment. In studying that problem we may well begin with a study of the degree of continuity of operation of the individual plants. What breaks the continuity? What causes shut-downs and lay-offs? Are these causes avoidable or controllable? What can be done to overcome them—or to safeguard against them?"

"Lack of orders" may mean faulty sales planning or management. Perhaps the price is too high, because production and selling costs are unnecessarily high. In such cases, simplification often permits a reduction of cost that affords a lower price to the public, and buying is thus stimulated. Price reduction is often a splendid cure for "lack of orders."

In the study of the "Regularization of Employment," Professor H. Feldman of Dartmouth says, "Perfect your sales program first, analyze your markets, simplify lines, reduce style hazard, etc." Through these methods, much can be done to bring in that volume of business which means continuous operation of the plant, and therefore steady employment for its workers, with consequent regular earnings and sustained or constant purchasing power.

If every manufacturer sought diligently to overcome the conditions that interfere with or prevent his plant running regularly and continuously the year 'round, the bogey of unemployment and consequent diminished purchasing power as evidenced in "lack of orders," etc., would vanish.

Abstract on Corset Wire

WHILE it is generally thought that corsets have gone out, the fact remains that many of these are being made daily and are absorbing a huge total of wire, largely flat stock. After its manufacture into wire, the wire makers are interested indirectly in its further manipulation. This article describes the plant of the Spirella Co., Niagara Falls, N. Y., from an electroplating viewpoint. The various departments include a corset-wire making machine room, a wire cutting room, storage room for stock, special cleaning room, corset making rooms, etc. In the electroplating unit, the plating of wire is done for all Spirella plants in the United States, while another across the Niagara Gorge, at Niagara Falls, Ont., supplies the Canadian plants. The sole idea of the plating is to produce wires that are absolutely rustproof, even when contending against such an active enemy as human perspiration. The storage room for wire stock is of hollow tile heated to a uniform temperature of 70 deg. F. throughout the year so there is no loss through rusting. Cleaning is accomplished by a so-called electric cleaner, the wire being handled in baskets, after being cut to lengths. In plating the wires, after thorough cleaning, they remain 45 mins. in the copper cyanide solution, 45 mins. in the acid copper bath, 20 mins. in the nickel tanks, and 90 mins. in the galvanizing tanks. From there they pass to the sawdust, used as the first step in the drying. About 5 lbs. of metal are deposited on each 100 lbs. of corset wire. It is said that more than two years were spent in working out the plans for this model plant, which includes all of the most modern safety devices. For instance an exhaust blower is used to draw the fumes from under the hoods which cover the cyanide tanks, both sliding hood covers and the blower being new safety ideas in the electroplating industry. —*Metal Record & Electroplater*, July, 1915.

The Manufacture of Insulated Cable in France

By George Kessler

Director, Cablerie de Jeumont, France

(Transl'd from La Technique Moderne by A. J. Michel)

Introduction

GENERALLY speaking, the theory, operation and manufacture of electric cables are very much alike whether it be a cable for power transmission or distribution, or an electric-light cable. The only factors which vary according to the employment and function of the cable are its insulation and protection.

For this reason we shall divide our subject matter and investigate first cables in general. After this we shall take up the manufacture of the various types of cables and conductors in current use.

One of the most interesting kind of cable, the subterranean power cable shall be given a short retrospective discussion.

Up to a recent date subterranean very high power cables have been used rather sparsely. It is true that for several years there have been in operation in various countries cable installations operating at tensions of 30,000, 35,000 and even 50,000 Volts; however, it has been only since 1919 that a considerable development has taken place in the manufacture and use of very high tension cables. Subterranean as well as open air lines have participated in this development and the voltages of the latter type of cable have been increased to 220,000 Volts.

As far as the open air electric cable is concerned its development did not have to depend upon the creation of a special science, since the satisfactory operation of an open air line only depends upon the insulators, the supports and the safety devices employed. We shall appreciate in this investigation that this is not the case as far as subterranean electric cables are concerned.

From a commercial and economic standpoint it is imperative for long transmission and distribution lines to be constructed in the open air, as overhead lines at least in the open spaces. When, however, the distribution has to take place inside of urban or "downtown" areas this kind of distributing system becomes impossible. For these reasons recourse must be had to subterranean high-tension distribution whenever the power involved attains several hundred KW.

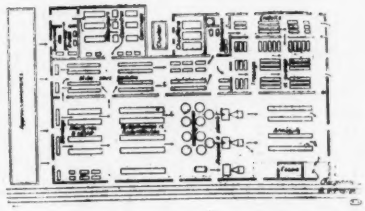

Fig. 2—Factory plan, showing cycle of operations.

We have examples of such constructions in the United States of America, and in England, where subterranean power cables are in operation having voltages of 66,000 Volts and more. We see another example in France, at Paris, where the power plant of Gennevilliers distributes 3-phase current of 60,000 Volts by means of a cable system comprising 650 km of subterranean cable.

For power plants of this importance, if in addition to the operating conditions the first cost of 1 KW of power distributed by the cable is taken into account, one appreciates that the solution of the problem consists in distributing the greatest amount of power possible in the same feeder; in other words, it is necessary to increase to a considerable extent the current density and the tension.

Only a few years ago when the majority of subterranean cables were designed for tensions ranging from 10,000 to 15,000 Volts, the construction of the cable systems was based upon mostly mechanical considerations. This state of affairs had to give way, owing to the scientific and economical character of the problem, to consideration based upon strictly scientific observations and investigations.

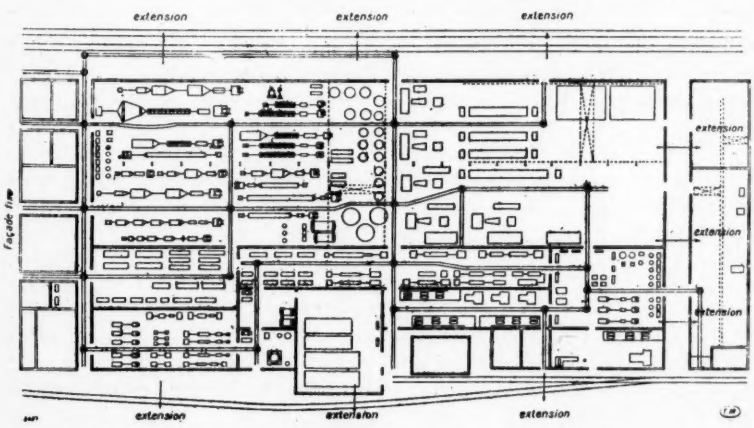

Fig. 1—Plan of factory showing general layout with possibilities for expansion.

WIRE SPOOLING and WINDING EQUIPMENT

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Among the scientific investigations brought to bear upon this subject were the choice of insulating material, the determination of the potential gradient, the distribution and nature of the electric field in 3-phase current cables, the measurement of heat losses and the measurement of dielectric losses.

In the art of telephony great developments have taken place in the design and operation of signalling cables. In this field as well as in the power field important extensions of the existing telephone and telegraph cables and the installation of multiple circuit lines are being contemplated in France.

In the majority of cases these circuits and lines are constituted by subterranean cables. Plans are under way for extending the existing signalling circuits and toll lines in a manner analogous to those existing in England and the United States. At the present time one portion of these circuits, namely the subterranean telephone cable from Paris to Strassburg comprising 150 circuits over a length of 500 KM is being completed.

At first sight it might appear on considering the developments taking place in wireless telephony and telegraphy that wire telephony and telegraphy was going to be superseded. This, however, not only is not the case, but its progress is increasing very rapidly. Several years ago a length of 40 KM was considered to be the extreme limit over which the voice could travel over a wire of 1 mm diameter. At the present time several hun-

dred circuits each constituted by 2 wires of 1 mm diameter are united to one cable extending over several hundred KM of length. It is true that these long telephone lines are not constituted only by the cables but that relays, amplifiers and induction coil are inserted into the circuits. However, even if it be granted that these devices play an important role, still we must emphasize that the wires making up these cables must be rigorously uniform, as any variation of their physical dimensions or properties plays havoc with the communication of voice currents.

We must also mention the manufacture of various kinds of conductors employed in interior installations and wirings, for lighting circuits, offices, factories, agricultural purposes, etc.

In this type of conductor rubber insulation in various forms is used. We shall thus see that the cable manufacturer must also be a good rubber expert at least to the extent involving this particular problem.

Among other important uses to which electric cables are being put are mining cables, ship cables, current generator—and motor wiring, etc.

In all these manufacturing fields the cable manufacturer has to work hand in hand with the electric machine manufacturer; he enables the latter to put his conception into practice in using as little copper as is compatible with the efficiency and weight of the manufactured machinery.

In addition to the cables proper cable manufacturers are very often concerned with production of the incidental devices and appartus required for the operation of the electric cables, such as junction boxes, splicing chambers, loading coilpots and boxes, etc. Often as much inventive effort and care of manufacture must be expended for developing and designing these accessories as for the cable proper. As far as low and medium tension cables are concerned the data and requisites for the manufacture of these incidentals are more or less standardized. This,

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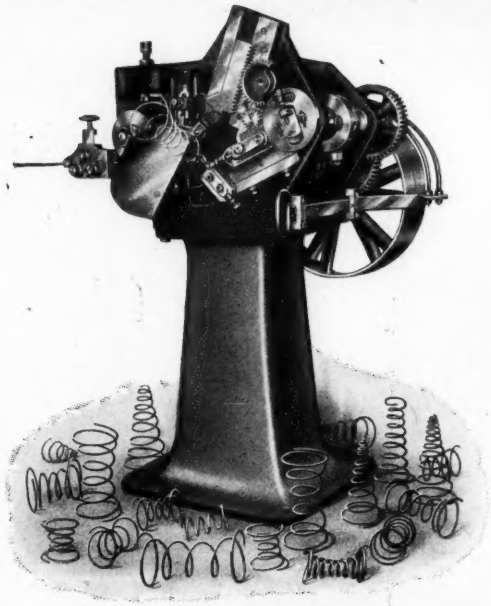

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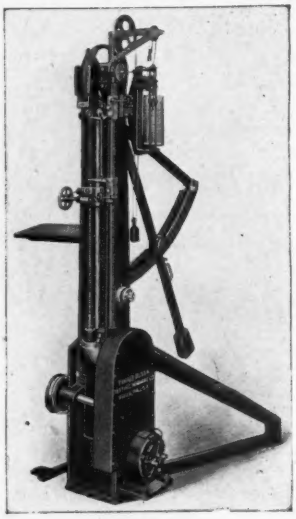
Made in capacities from 50 lbs. to 1000 lbs.



This illustration is of the very latest up-to-date Autographic Wire Tester which will scribe the stress strain diagram on square cross-section paper, correcting for the sine angle of the pendulum to magnify the elongation of the wire ten times. The autographic record may be taken directly from the wire, and thus the greatest of accuracy secured in such a record, as we do not consider any autographic record or wire test as satisfactory or acceptable taken from the motion of the heads of the testing machine.

Olsen Autographic Wire Testers can also be secured of capacities from 10,000 lbs. up to 1,000,000 lbs. capacity for testing steel, copper or brass wire of all gauges, as well as the largest wire rope made.

Also manufacturers of Olsen Static-Dynamic Balancing Machine equipment for balancing high speed rotating parts, which will eliminate vibration and increase efficiency and production of all high speed machinery.

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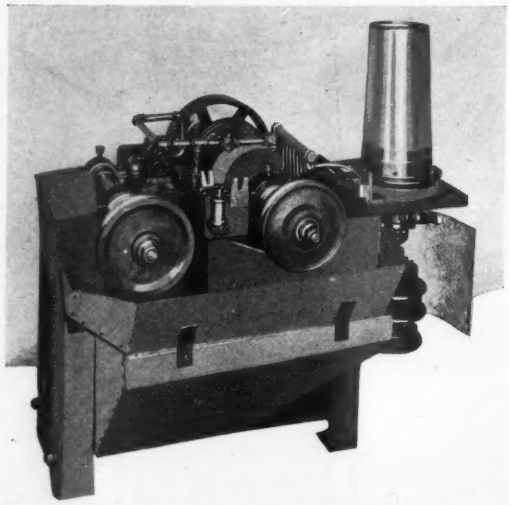
NEW IMPROVED TYPE

Superior Wire Drawing Machine

An 8 draft continuous machine for copper or steel wire.
Clutch action on spindel and main drive.
All gears are enclosed in an oil tight case.
Ball bearings throughout.

Designers and Builders of Wire Drawing and Special Machinery



The Superior Tool & Mfg. Co.

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however, is not the case when high tension cables are being designed, as here the junction boxes and other pots and accessories have to be designed with great care, and the dielectric properties, the heating phenomena and the electric field distribution have to be studied very accurately. If this is well taken care of the accessories are no longer points of least resistance or possible trouble-makers but as reliable as the remainder of the line. Finally it may be stated that the research laboratories play an important role in the scientific investigation and economical designing of electric cable construction and installation. We shall revert to their important role below.

Layout of Cable Factory

The products of cable factories may be divided as follows:

1. Underground cables for power transmission and distribution.
2. Telephone and telegraph cables.
3. Rubber insulated wires and cables.
4. Wiring conductors to be used in windings of electric generators and motors.

Many manufacturers specialize in one or several of these products. However we shall here consider the case where these various types of cables and conductors are manufactured in the same plant.

Instead of entering immediately into technical details of manufacture, we shall commence with a general study of factory operation in considering certain guiding principles to be followed by the designer and manufacturer, endeavoring to render a practical account of our experience. The information concerning this industry is very meager. The few publications, domestic as well as foreign, relating to this subject are either technical abstracts devoid of practical suggestions, or they are concerned with the raw materials entering into the manufacture, and not with factory or milling practice.

As will be easily understood from economical considerations

the layout of the mill and the arrangement of the machinery should be such as to utilize to best advantage the available floor area and should be compatible with the best of mechanical and handling practice. On the other hand, the available floor space should be judiciously subdivided and laid out in such a

(*Continued on page 288*)

New Installations Stewart-Hartshorn Plant

(*Continued from page 264*)

$180.00 a year for wire machines and $125.00 a year for two sets of motors and electrical equipment. Actual repair charges have been almost negligible to date and cannot be used as a basis for the determination of annual averages.

The total of all fixed charges is $1,449 42 a year or $5.58 a day.

Lubrication, die and die lubricant costs are detailed in tabular form. Power is figured at $.03 per kw.-hr. on the basis of an observed input of 17.57 kw. per machine. The total of all machine costs is $16.07 a day or $.47 per hundred pounds of wire on the basis of the present 9-hour production of 3,400 lb. as determined from an average five-day run.

Savings Effected

The major economic advantage of the Morgan-Connor machines come through reduction of labor cost. The unit cost of operating the old single-block machines, including fixed charges, maintenance, supplies and power, was at least equal to that on the newer equipment and the labor cost reduction is therefore a net saving creditable to the application of the improved method.

The reduction from No. 9 to No. 15 was formerly made in two steps with one man assigned to each. The rates paid were $.21 per hundred pounds for the reduction from No. 9 to No. 12 and $.24 per hundred pound for the reduction from No. 12 to No. 15. The total labor cost, including die-making labor, was $.45 per hundred pounds. The present cost is $.21, total, per hundred pounds for operating labor plus $.08 per hundred pounds for die making labor—a total of $ 29 which represents a cost reduction of 35.5% net.

The labor saving alone amounts to $5.44 per 9-hour day or $1,414.40 for a 260-day operating year.

Compared with what would be required for an equal productive capacity in the old single-block machines, the 6 Morgan-Connor units are saving a total of 3,500 square feet of floor space. This amounts to about 1667 square feet for each 2-machine battery and the space is valued at $291.75 a year.

The total of the above savings —$1,706.15 a year or $.19 per hundred pounds of wire—gives a net annual return of 12.1% on the total initial investment. The net annual saving on the six Type A machines is $5,188.45.

Further Advantages

The labor and floor space savings are ample to justify the installation of Morgan-Connor machines from the economic standpoint alone but they are by no means a complete indication of the benefits derived. The following paragraphs will show a few of the practical advantages.

Safety is an important feature. The operator's control bar extends along the entire length of the Morgan-Connor machine. It is impossible for an operator to be seriously injured because the power is automatically cut off when the bar is pushed in if the man is caught and drawn toward the blocks.

Wire is fed from the floor to No. 1 block only. This is at comparatively slow speed and eliminates all danger associated with the use of high-speed reels on the working floor.

The reel feeding No. 1 block is mounted on a tilting base which has a switch connection so arranged that a tangled wire will tilt the reel and automatically shut off the power.

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Back in 1866 while we were still in the scale business, S. Fulton and Co., manufacturers of cast iron pipe, were having trouble with rejections of their product. Mr. Fulton suggested that they

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and ask us to solve their problem. Thus we designed and made the first Testing Machine. It was crude but served the purpose, and after that the engineering profession continued to

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to solve their testing problems, until now we make over a thousand different machines and appliances to meet the countless needs of the physical testing field. If you are contemplating purchasing a Testing Machine, or desire catalogues and information

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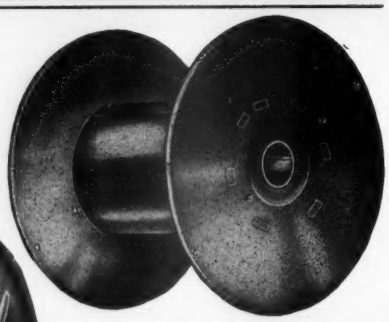
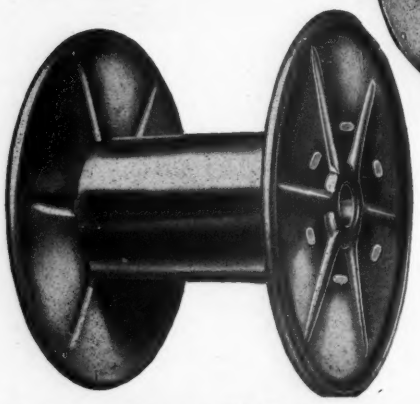
Specializing in the Manufacturing of REELS & SPOOLS of all sizes.



For Annealing and Handling Fine Wire



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For Wire, Sheet Metals and Other Materials

A simple, practical recording tensile testing machine

Maximum Capacity 2000 lbs.

The test results are automatically recorded on standard letter size forms (8½x11 in.) The machine is easily handled; is safe and strong and free from delicate parts. Does not require a trained operator or technical man.

Manufactured By

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A sliding-chain tension arrangement is provided on each drum so that wire is ordinarily kept on the sheaves without any attention from the operator.

Less handling of wire is an important advantage also. Wire is passed completely through four drafts with only one stripping and there is, therefore, a 75% reduction in the physical effort required of the operator compared with what would be necessary with the single-block method.

Summary

Stewart Hartshorn Company draws spring wire on 6 Morgan-Connor machines, making many practical and economic gains over single-draft method formerly used.

Reduction initially from No. 5 rod having .70 to .80% carbon and .38 to .40% manganese. Morgan-Connor machines then make four drafts through chilled-iron and steel dies to reduce from No. 9 to No. 15 gage running through last block at 325 f. p. m.

Repair costs negligible to date, operating costs no greater than for single-draft method, labor cost reduced 35.5% net from $.45 to $.29, total, per hundred pounds.

Savings shown:

For two machines working 9 hours a day—

$1,414.40 a year in labor
291.75 a year in floor space

$1,706.15 a year, total

For six machines—

$5,118.45 a year, total

Advantages are:

Greater safety
Less handling of wire
Low scrap

Galvanization of Iron and Steel Wire

(*Continued from page 273*)

ing machines. Such an arrangement permits uninterrupted operation. The individual wires are simply attached to one another as they undergo treatment. The guide-rollers have

to be of porcelain or fire-clay. Blank-drawn or annealed wire is best suited for galvanization as its pickling is comparatively easy. Oiled or greased wire requires washing in a solution of hot caustic soda before it can undergo the actual pickling process which should be performed in sandstone troughs containing a solution (13 to 20%) of hydrochloric acid. The wire is pickled in quantities of 500 to 1000 kg. The pickled wire is spooled upon reels and passes into a solution of muriatic acid. The remains are washed off in a separate tank, a skimming apparatus removes the moisture, and the wire thus prepared passes into the galvanization tub. Rolled and annealed wire requires an especially long and intense pickling as the scale has to be removed. Langbein recommends for this purpose a solution of caustic soda. He runs the wire through felt—or cloth-lined rollers which have been saturated with lime paste and rinses it vigorously by showering. This method is especially suited for steel-wire which can't be pickled. The iron-oxide of the scale, too can be easily removed by running the wire as anode.

The zincing tubs should be of larchwood—other woods harden through the gradual zinc-saturation and begin to leak—and have to be lined with asphalt or sheet-lead. They measure 2 to 3m in width, to 15m in length, and ½ to ¾m in depth, according to the average volume of wire that has to be galvanized Plates of chemically pure zinc serve as anodes. These plates usually measure 1.5cm in diameter and 1m in length. They are arranged in groups and placed into the tubs. Each group is suspended from a copper-bar which is connected with the main cable. The distance between the individual groups suffices to permit the wires to pass in between, and measures 4 to 10 cm according to the thickness of the wire. Care has to be taken that the knots too can pass. The anodes are connected with the current dis-

LAVITE is the BEST Annealing Equipment Investment

Here is a record on wire annealing:

The former cost on high grade alloy wire was $12.00 to $22.00 per unit charge. This cost was reduced in the **Lavite Annealing** to $4.30 and better wire obtained.

Here is another record:

The cost of annealing and cleaning low carbon wire under continuous production conditions was $4.60 per ton. This was reduced by **Lavite Annealing** to $2.70.

LAVITE is the BEST HEATING MEDIUM.

No other method of heating gives perfect heat transference, uniformity, and neutrality to metals. Because of its peculiar properties, Lavite can be used thru a range of 1000 degrees without any change or deterioration. It is the only heating medium which is neutral to metals thru this wide temperature range.

Can you afford not to invest in a Lavite installation?

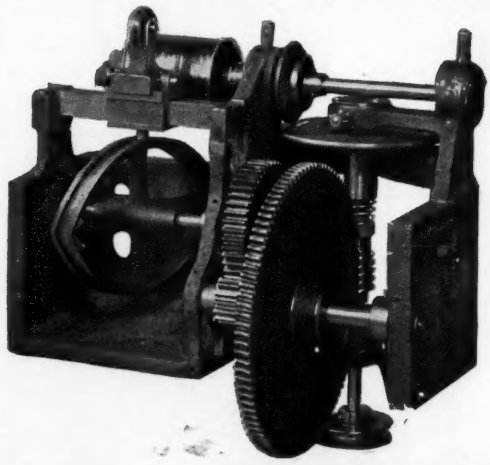
Write for details on your annealing proposition.

THE BELLIS HEAT TREATING CO.

BRANFORD, CONN.

Spooling Attachment

Spools wire from .018 to .003 **Dimensions 12"x12"x15"**
Weight Approximately 50 lbs. **Ball bearing equipped**



The above illustration shows an open view of our No. 1 Spooler. All gears are enclosed.

Uniform tension and lay of the wire on the Spool is assured by the use of a screw cam. It is inexpensive, simple to operate and can quickly be attached to any machine.

CYRUS CURRIER & SONS

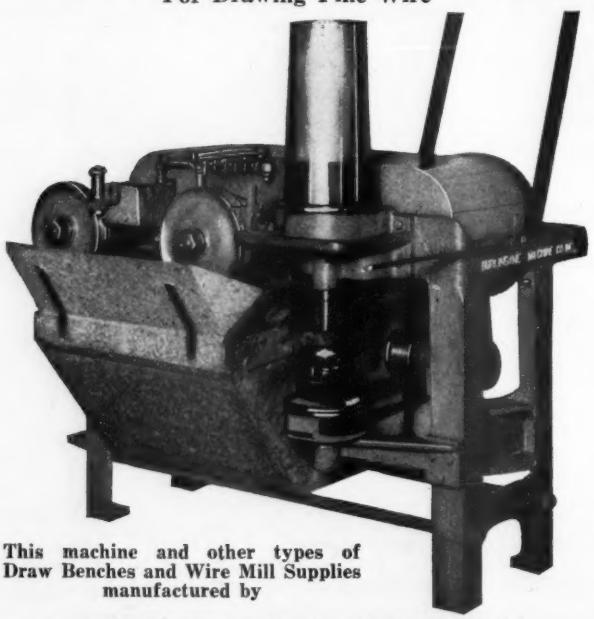
365 Market St. **NEWARK, N. J.**

charging copper-bar by means of zinc-tap so as to assure utmost exploitation of the plates. One suspends the anodes only along side of one another but not above of one another as it has been discovered that the bubbles which are formed on the treated wire make the upper ones useless. The manufacturers of galvanizing plants follow the example of the manufacturers of hot-zincing plants and do not communicate the manner in which they transmit the current from the negative main cable. It can be assumed, however, that the wire is charged by means of the transportation rollers at the end of the tub.

The wire runs under current through the zincing bath, is washed in a hot water tank, and spooled upon reels with variable speed. The arrangement of the drums is the same as described under hot-zincing.

The anodes as well as the transportation-rollers are connected with the same main cable in order to assure uniform feeding. Both poles are fed from copper bars which in turn are connected with the main cable. The connection should be well insulated in order to prevent unnecessary loss of voltage. The dynamo usually is placed between the zincing tubs. This location too helps to prevent loss of voltage through "cable-resistance," and assures convenient and economic feeding through comparatively light copper cables. An intermediate coil is inserted to keep the voltage always constant. Short circuit only occurs if the wires touch the anodes and registers instantly as a large deflection of the ammeter. Interruption, such as burning of the refuses, results in increased voltage. Voltage and density of current determine the temperature which has to be kept constant by steam heated spiral-pipes in order to assure perfectly even coatings. It is not our intention to treat the processes which help to increase the density, flexibility, and lustre of the zinc-coating as this is a field that has to be considered separately.

Continuous Wire Drawing Machine
6 Draft **Liquor Finish**
For Drawing Fine Wire



This machine and other types of Draw Benches and Wire Mill Supplies manufactured by

BURLINGAME MACHINE CO.
149 COMMERCIAL ST., WORCESTER, MASS.

Galvanic Zincing of Nails, Screws, Etc.

Galvanization produces an exceptionally clean and smooth coating and is well adapted for the zincing of small mass articles. Such items are zinced in especially constructed devices. It used to be customary to place such small articles simply on a ladle, to connect the ladle with a negative pole, to place a positive zinc-plate above it, and to dip and shake over a certain period of time. To-day, especially designed devices, the so called "rocking-apparatus" and the "rotating-zincing-tank," take the place of this more or less primitive method. Both devices facilitate perpetual rocking of the ware and produce excellent results. A "rotating-zincing-tank" usually consists of a semi-cylindrical vessel which contains the goods and the zincing solution. The vessel is connected with a negative pole and revolves around a shaft. It may be entirely out of conducting metal or wood and celluloid with inlaid contacts. Its bottom is ribbed so as to prevent sticking of the ware. This tank is moved to and fro by a crank and contains beside the solution and the ware a prismoidal zinc-anode which is suspended in the center.

Some rocking devices contain a second vessel. This second vessel contains the wire-ware and is connected with a negative pole. These constructions carry the zinc-anode on the central shaft. The anode, however, has to be covered with a perforated celluloid-hull, which prevents contact with the treated ware and short circuits. Several rocking devices provide for automatic filling and automatic discharge of the zinced material as well as of the zincing solution, thus facilitating utmost efficiency in mass-zincing.

An attempt has been made to replace the copper-contacts, which offer no resistance against zinc-deposits, through aluminum as the latter has the very property that is lacking in copper.

Langbein and Buchner recommend various solutions for zincing purposes. Mass articles offer considerable current re-

sistance and have to be zinced under a voltage of 10 to 12 v in connection with a current density of 4 to 6 amp, per sq. m. of wire-surface.

The articles have to be cleaned in rotating sawdust drums, boiled in caustic soda, and pickled, before the actual zincing process can take place. The threads of screws are treated with tallow in order to prevent their galvanization.

This article will be concluded in the Sept. issue.

Support For Reinforcing Mesh

(*Continued from page 265*)

fulness this method gave fair results, but was far from satisfactory.

The plan of the bar and hooks as worked out by the two California Highway engineers (Mr. W. D. Eaton and Mr. Walter T. Lamb) seems to have many advantages over any other methods. By it, the wire mesh of bars may be placed in correct position and held there. Numerous tests of the position of the reinforcing after tamping of the fresh concrete demonstrate this to be a fact.

The device is left in position until the concrete is spread and is removed just ahead of the tamper.

Relation of Steel Quality to Drawing

(*Continued from page 269*)

ing at a higher temperature, a piece of the same wire was annealed at 820° C. with the result shown in Fig. 43. These wires, although giving very similar properties in the annealed state, showed vastly different physical test results after drawing one hole to 11 gauge.

Low tensile strength is, therefore, no criterion of well- anneal-

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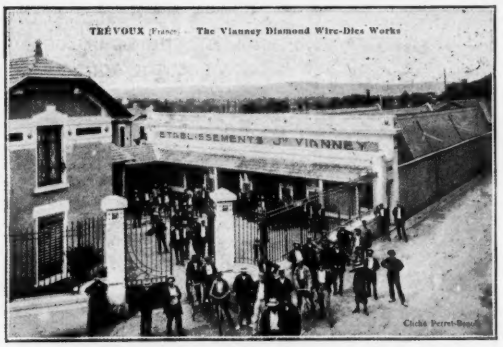

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ed wire. In the case of the wire annealed at 720° C. the pearlite remained as drawn-out running indiscriminately through the ferrite grains.

In the two cases mentioned above it will be observed that whilst the tensile strength and elongation are the same, the physical properties, as measured by twists, bends, and snarls, are all in favour of annealing at the higher temperature. Very low carbon wire can be well enough annealed at 700° C. for all practical purposes, but if the carbon approaches 0.12 per cent. the effect will be disastrous if the material is to be drawn to fine sizes after annealing. These facts show at what a disadvantage the wire manufacturer is placed in endeavoring to use mild steel of mixed carbon content.

Cementite in Mild Steel Wire

Cementite in annealed mild steel wire confers very unfavourable properties on the finer wire subsequently drawn from it. Evidence of this is mainly shown in lack of tensile strength and snarling properties. Also the ductility of the steel is usually so impaired that to attempt to draw it more than two passes causes breakage, the quantity of breakage depending upon the amount and size of cementite at the grain boundaries.

The formation of cementite in mild steel appears to be due to the change in grain-size taking place below the lower critical point Ac_1. The cementite seems to diffuse through the ferrite, its diffusive power apparently increasing as the temperature gets nearer to Ac_1. In any case, it appears that the cementite segregate formed after annealing always shows up at the grain boundaries. As the pearlite from which the cementite is formed is in an elongated form it must, therefore, have travelled by a process of solid diffusion to the re-formed ferrite boundaries. The cementite particles appear to accumulate at these points, and segregate as films partially surrounding the grains, owing to the fact that conditions of temperature necessary for eutectoid formation are not present. Even with the enormous grain-growth produced by annealing after critical straining the cementite can always be found at the grain boundaries (Fig. 44).

The slow heating and cooling associated with pot annealing is particularly favourable for changes in grain-size, and, even if the temperature obtained exceeds the Ac_1 point and pearlite separates, the subsequent slow cooling is often sufficient to cause alterations in grain-size and the formation of cementite.

In these cases it would appear that the steelmaker should not be blamed for unsuitable qualities of steel, but the methods of annealing which give quicker heating and cooling would certainly be advantageous.

Effect of Varying Analyses on Tempering

Another case of wrong heat treatment which is sometimes put down to bad steel is illustrated by Fig. 46.

A steel rod analysing carbon 0.71 per cent., and manganese 0.84 per cent., while passing through the patenting furnace was found to give patches of alternate hard and tough material. By taking a piece of wire which was tough at one end and hard at the other and carefully tracing back, it was found that in a length of 0.15 in. the material was completely changed from martensite to sorbite, showing that the rate of cooling had been so critical that the least alteration in conditions gave either one or the other structure.

A panorama of five micrographs was taken over the 0.15 in. length, and is reproduced in the form of a zigzag strip, Fig. 46, which shows the martensite at the top end and the complete change to the sorbite at the bottom. The furnaceman naturally

blamed the quality of the steel whereas a little change in the process would have produced excellent material.

Defects Developed Through Misuse of Wire.

In addition to the fictitous complaints which the steelmaker has to put up with from the manufacturer, there are also those which are sometimes made by the user of the articles made from the steel. One illustration in connection with a wire rope may be sufficient to give point to this.

A micrograph of longitudinal section of a wire from a steel rope is shown in Fig. 45. Complaint was made that the rope had been manufactured from bad quality wire or steel as the case might be, whereas careful examination of the surfaces of the fractured wires showed that they had been subjected to such intense friction that the skin was converted into the martensitic form, as shown by the white band along the upper edge of the wire in the micrograph. Two complete cracks through this band are also shown. After such conditions had been engendered it will readily be understood that the wires of the rope would fracture.

Object of the Paper

In conclusion, it may be said that a very wide field has intentionally been covered by this paper with the threefold object of **(a)** raising a useful discussion on the best and most economical method of producing clean steel for wire-drawing purposes, **(b)** showing the necessity of co-operation between the wire manufacturer and steelmaker, and **(c)** dealing with problems from a works point of view without presenting undue technical details, so as to enlist the help of the practical man.

Thanks are due to Messrs, Rylands Bros. for permission to publish the investigations which have been carried out at their laboratory, and also to Mr. H. N. Marr for the analytical, and Messrs. R. Brown and J. Williams for the microscopic, work in connection with this paper.

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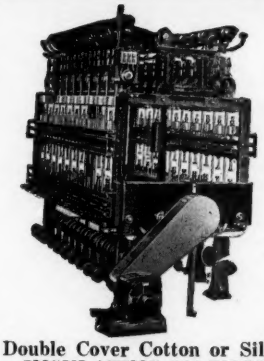

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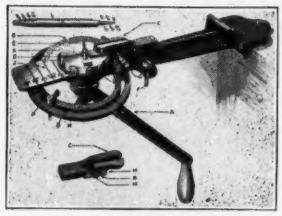

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Domestic Exports of Iron and Steel Wire, Wire Rope and Nails, From the United States, By Countries

May, 1927

Countries	Plain iron or steel wire	Galvanized wire	Barbed wire	Wire rope	Insulated iron or steel wire and cable	Wire nails
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Azores & Maderia Is.	.....	.....	.....	.....	1,664	.....
Bulgaria	.....	.....	.....	.....	246	.....
Denmark & Fr. Is.	132	.....	.....	.....	.....	100
France	7,058	.....	.....	.....	.....	.....
Italy	.....	.....	.....	527	.....	.....
Netherlands	.....	.....	.....	.....	.....	36
Norway	.....	.....	.....	.....	.....	110
Soviet Russia in Europe	.....	.....	.....	7,615	.....	.....
Spain	1,110	.....	.....	.....	.....	.....
Sweden	300	.....	.....	.....	.....	.....
Switzerland	7,589	.....	.....	.....	.....	.....
United King.	97,363	99,703	.....	351	1,511	43,990
Canada	809,696	2,815,085	1,319,520	27,381	17,219	12,150
B. Honduras	.....	.....	8,000	.....	.....	428
Costa Rica	.....	.....	.....	13,243	.....	573
Guatemala	100	.....	142,800	2,204	1,047	15,867
Honduras	174	5,510	36,000	.....	1,017	29,719
Nicaragua	211	867	37,975	1,082	.....	13,600
Panama	5,210	7,200	129,325	76,619	.....	38,226
Salvador	.....	2,412	100,500	1,630	117	29,200
Mexico	291,907	94,142	1,074,029	166,797	8,066	44,133
Newfoundland & Labrador	1,521	.....	2,000	15	.....	2,000
Miquelon & St. Pierre Is.	.....	.....	.....	.....	920	.....
Bermuda	250	1,698	.....	.....	.....	922
Jamaica	160	2,277	3,112	.....	.....	505
Trinidad & Tobago	10,480	155	.....	20,733	1,671	6,000
Other B. W. Ind.	.....	4,206	6,000	78	.....	16,000
Cuba	111,078	193,260	782,441	35,641	1,740	161,119
Dominican Rep.	26,280	5,508	143,098	4,170	1,455	52,400
D. W. Indies	.....	400	5,766	3,789	.....	1,054
Haitian Rep.	.....	1,050	8,900	54	.....	30,336
F. W. Indies	.....	.....	.....	.....	.....	1,300
Virgin Is. of U. S.	.....	.....	3,116	.....	.....	3,270
Argentina	255,595	.....	1,094,222	46,440	539	1,335
Bolivia	.....	.....	.....	.....	3,662	.....
Brazil	63,866	78,121	2,815,163	489	.....	2,700
Chile	3,800	410	.....	31,444	.....	195,120
Colombia	81,988	116,895	758,426	18,122	1,257	467,589
Ecuador	444	.....	36,000	.....	.....	43
B. Guiana	.....	10,000	.....	.....	.....	.....
D. Guiana	.....	441	.....	560	.....	.....
Peru	.....	84,534	213,000	59,564	6,685	37,700
Uruguay	94,395	58,800	38,581	145	.....	.....
Venezuela	1,600	6,578	119,280	2,617	.....	6,880
B. India	.....	.....	.....	.....	44,510	.....
China	245,455	.....	.....	.....	.....	.....
Java & Madura	.....	.....	100,104	12,435	.....	1,510
Other D. E. Ind.	.....	.....	83,634	280,002	.....	.....
Hongkong	50,650	.....	.....	.....	.....	.....
Japan, inc. Chosen	23,438	174,012	.....	4,112	420	1,594
Philippine Is.	25,100	141,607	777,180	83,756	414	158,961
Siam	.....	.....	.....	2,138	.....	.....
Australia	318,023	39,933	2,240	26,478	12,800	9,385
F. Oceania	.....	.....	600	110	.....	450
N. Zealand	37,385	.....	.....	.....	116	.....
B. S. Africa	.....	140,000	460,530	.....	256	110
B. W. Africa	.....	.....	.....	.....	.....	546
Portuguese E. Africa	.....	.....	50,500	.....	600	.....
Total Quantities	2,572,358	4,084,804	10,352,042	930,341	107,932	1,386,961
Total Values	117,844	136,864	311,587	122,323	18,983	50,712

Manufacture of Cables in France

(*Continued from page 281*)

way that between the individual machines sufficient free space is provided for enabling the handling of the required number of spools, the diameter of which varies between 1 m. and 2.60 m.

It is obvious that careful planning must be exercised in laying out and coordinating the respective placement of the individual mill sections. Provision must be made for a steam installation for supplying heat, drying and impregnating machinery as well as rubber mixers, boilers, cauldrons, etc. It is also necessary to provide canalizations for cold water, compressed air, gas and vacuum. In a general layout of the plant the eventual increase in size of the factory of sections thereof should be borne in mind. Only too often does it happen that a plant is badly coordinated and its sections devoid of economical cooperation because the original layout failed to discount the future.

Domestic Exports of Iron and Steel Wire Manufactures, Horseshoe Nails and Horseshoes From the United States, By Countries

May, 1927

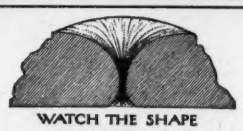
Countries	Woven wire fencing	Wire cloth & screening		Wire n. e. s. & manufactures of	Horseshoe nails	Horseshoes
	Pounds	Pounds	Dollars	Pounds	Pounds	Pounds
Azores & Maderia Is.	.....	147	38	.....	.....	.....
Belgium	.....	.....	.....	1,057	.....	.....
Czechoslovakia	.....	.....	.....	23	.....	.....
Denmark & Fr. Is.	.....	.....	.....	1,539	.....	.....
Finland	.....	.....	.....	502	.....	.....
France	26,216	.....	.....	18,477	.....	.....
Germany	100	.....	.....	96	.....	.....
Greece	.....	.....	.....	60	.....	.....
Irish Free State	.....	.....	.....	377	.....	.....
Italy	.....	.....	.....	.....	2,750	.....
Netherlands	.....	.....	.....	622	.....	.....
Norway	21,017	.....	.....	1,945	.....	.....
Portugal	.....	.....	.....	97	.....	.....
Soviet Russia in E.	.....	1,922	379	.....	.....	.....
Spain	.....	.....	.....	2,014	.....	.....
Sweden	.....	.....	.....	4,371	.....	.....
Switzerland	.....	.....	.....	680	.....	.....
United King.	256,712	326	116	155,128	500	.....
Canada	296,404	95,848	15,506	594,328	325	3,725
B. Honduras	.....	.....	.....	.....	.....	200
Costa Rica	.....	504	33	119	1,500	10,500
Guatemala	.....	1,776	359	18,183	1,000	.....
Honduras	3,018	58	23	460	.....	200
Nicaragua	409	585	63	9,476	309	1,631
Panama	13,783	10,458	992	9,783	200	4,210
Salvador	.....	4,845	414	394	.....	.....
Mexico	38.596	53,022	8,593	314,948	16,553	12,205
Newfoundland & Labrador	2,370	1,495	253	2,601	.....	.....
Bermuda	1,000	1,239	290	2.975	.....	614
Barbados	.....	110	22	3,977	.....	.....
Jamaica	1,038	976	216	1,814	.....	.....
Trinidad & Tobago	3.823	2.191	529	5,895	.....	.....
Other B. W. Indies	3.303	1.015	178	.....	.....	.....
Cuba	99,421	25,277	3,560	116,676	44,600	1,712
Dominican Rep.	1.000	4,563	574	14.101	100	1,000
D. W. Ind.	15,287	.....	.....	3,891	.....	.....
Haitian Rep.	.....	562	134	1,448	.....	.....
Virgin Is. of U. S.	1,678	.....	.....	80	200	.....
Argentina	3,169	8.897	1,971	11,200	.....	8,000
Bolivia	.....	23.789	4.823	6,384	.....	.....
Brazil	4.520	102,287	4,609	13.115	.....	.....
Chile	1,514	.....	.....	23,543	100	.....
Colombia	8.040	8,029	1,366	96,030	21,050	.....
Ecuador	3,960	.....	.....	86	2,000	.....
B. Guiana	3,162	.....	.....	.....	.....	.....
F. Guiana	.....	1.676	295	.....	.....	.....
Peru	27,470	13,312	1,104	3,445	.....	.....
Uruguay	.....	.....	.....	5,525	2,205	.....
Venezuela	.....	1,553	289	5,935	.....	.....
Arabia & Hejaz	.....	.....	.....	1,071	.....	.....
B. India	96,172	9,228	1,056	166,634	.....	.....
B. Malaya	393	.....	.....	.....	.....	.....
Ceylon	.....	197	111	.....	.....	.....
China	3,137	38,298	7,067	195,887	3,850	.....
Java & Madura	.....	.....	.....	98	.....	.....
Other D. E. Ind.	.....	.....	.....	812	.....	.....
Hongkong	.....	785	119	157	.....	.....
Philippine Islands	90.638	24.972	3,895	12.265	4,420	74,086
Japan, inc. Chosen	2,078	4.617	854	86,574	511	.....
Turkey in Asia	.....	3.106	521	.....	.....	.....
Australia	.....	55,830	8,888	100,405	2,700	.....
B. Oceania	.....	.....	.....	102	.....	.....
F. Oceania	.....	.....	.....	.....	.....	400
N. Zealand	.....	604	339	5,886	13,500	.....
B. E. Africa	6,576	90	22	.....	.....	.....
Belgian Congo	.....	45	15	.....	.....	.....
B. S. Africa	2,695	17,045	4,576	6,927	.....	.....
B. W. Africa	.....	.....	.....	160	.....	.....
Egypt	.....	.....	.....	67	.....	.....
Liberia	520	336	16	.....	.....	.....
Portuguese E. Africa	.....	2,499	485	1,366	.....	.....
Canary Is.	.....	.....	.....	130	.....	.....
Total Quantities	**1,039,219**	**524,114**	.....	**2,031,941**	**118.373**	**118.483**
Total Values	**49,217**	.....	**74,693**	**181,799**	**14,475**	**8,475**

In figure 1 is shown which has been planned with a view to a possible extension along three sides.

Another possible layout assumes the shape of a horse shoe, the future possible extension of which may take place toward the outside, the inside comprising multiple-floor buildings.

In figure 2 is illustrated the successive cycles of operation from the origin of the cable, namely the copper wire. We shall describe and explain without including in our subject purely theoretical considerations which lie beyond the scope of this article.

To be continued in Sept. issue.



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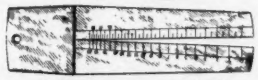

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MACHINERY—Armoring (Cable, Wire, Hose)
J. I. Bernitz, New York.
Sleeper & Hartley, Inc., Worcester, Mass.
W. E. Sommerville, Coal City, Ill.

MACHINERY—Balancing
Herman A. Holz, New York.
Henry L. Scott Co., Providence, R. I.

MACHINERY—Bundling
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Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

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J. I. Bernitz, New York.
Hallden Machine Co., Thomaston, Conn.
The F. B. Shuster Co., New Haven, Conn.

WIRE WEAVING LOOMS
M. A. Irmischer, New York.

MACHINERY—Coiling
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Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Chain Forming
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M. A. Irmischer, New York.

MACHINERY—Electric Chain Welding
J. I. Bernitz, New York.
M. A. Irmischer, New York.

MACHINERY—Forming
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M. A. Irmischer, New York.
Sleeper & Hartley, Inc., Worcester, Mass.
M. D. Kilmer & Co., Cleveland, Ohio.

MACHINERY—Gem Clip
J. I. Bernitz, New York.
M. A. Irmischer

MACHINERY—Insulating
American Insulating Machinery Co., Philadelphia, Pa.

MACHINERY—Nail
J. I. Bernitz, New York.
M. A. Irmischer, New York.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Pointing
M. A. Irmischer, New York.
Morgan Construction Co., Worcester, Mass.
Standard Machine Works, Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Pin & Needle
J. I. Bernitz, New York.
M. A. Irmischer, New York.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Spring Making
J. I. Bernitz, New York.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
J. I. Bernitz, New York.
Sleeper & Hartley, Inc., Worcester, Mass.
M. A. Irmischer, New York.

MACHINERY—Straightening
J. I. Bernitz, New York.
Hallden Machine Co., Thomaston, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
M. A. Irmischer, New York.
F. B. Shuster Co., New Haven, Conn.

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J. I. Bernitz, New York.
Cyrus Currier, Newark, N. J.
M. A. Irmischer, New York.
New England Wire Machinery Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
W. E. Sommerville, Coal City, Ill.

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American Insulating Machinery Co., Philadelphia, Pa.
Cyrus Currier, Newark, N. J.
M. A. Irmischer, New York.
Chas. Koegel Sons, Co.

MACHINERY—Panning
American Insulating Machinery Co., Philadelphia, Pa.

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Herman A. Holz, New York.
Riehle Bros., Phila., Pa.
Henry L. Scott Co.
Tinius Olsen, Phila., Pa.

MACHINERY—Winding
J. I. Bernitz, New York.
Sleeper & Hartley, Inc., Worcester, Mass.

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American Insulating Machinery Co., Philadelphia, Pa.
Broden Const. Co., Cleveland, Ohio.
Burlingame Machine Co.
Cyrus Currier, Newark, N. J.
Kratos Wks., N. Y. C.
Morgan Construction Co., Worcester, Mass.
M. A. Irmischer, New York.
National Alloyed Metals Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Mfg. Co., Worcester, Mass.
The Vaughn Machinery Co., Cuyahoga Falls, Ohio.
W. E. Sommerville, Coal City, Ill.
Waterbury Farrel Fdry. & Machine Co., Waterbury

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Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

RODS—Steel
H. B. A. Steel Co., New York

PRESSES—Rivet & Bolt
M. A. Irmischer, New York.

SOAPS—Wire Drawing
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T. J. Robertson Co., Syracuse, N. Y.

SPOOLS—Wire & Cable
American Pulley Co., Philadelphia, Pa.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TOOLS—Diamond
F. Krause & Co., Inc., Jersey City, N. J.
Paul Steiner, New York.
The Waterbury Wire Die Co., Waterbury, Conn.

TRUCKS
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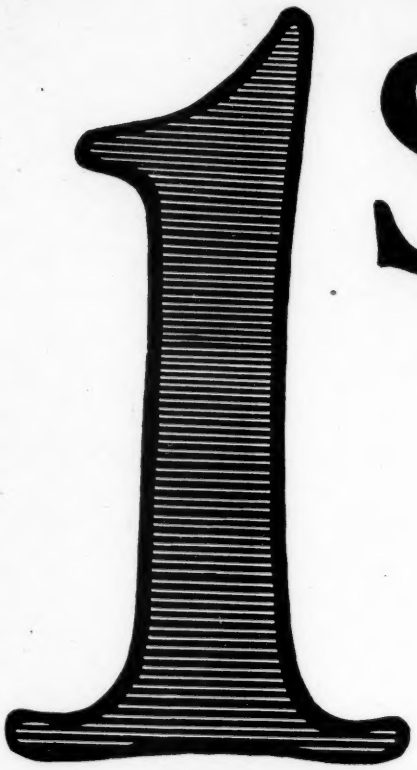

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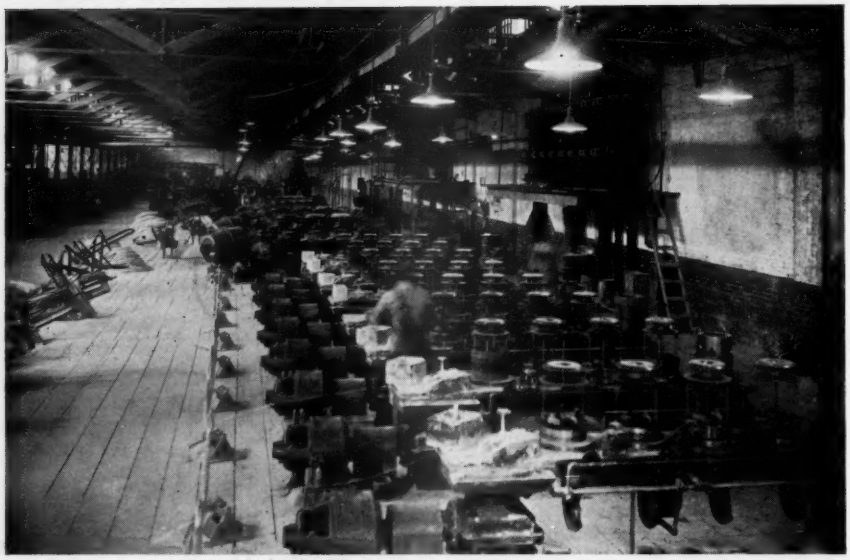

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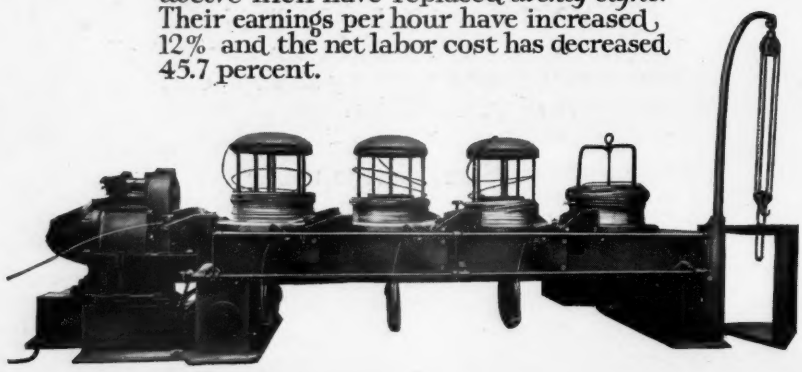

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